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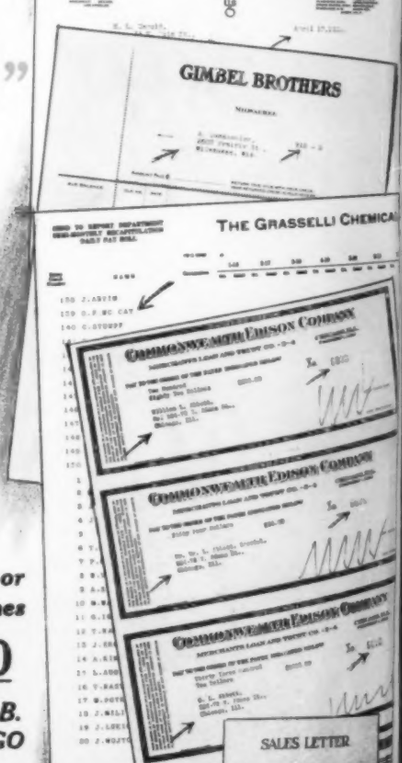

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(6-22)

With the Editors

SOME years ago we were in the habit of receiving contributions from Germany altogether in German; and among the correspondents who thus served us was Dr. Alfred Gradenwitz. One day we got a letter from him, the gist of which was that he had concluded that he would serve us better if he sent his stories in English; that he was studying the language, and would shortly begin using it in his manuscripts. We awaited the event with some trepidation; the efforts of a Teuton to write in a foreign tongue which he has taken up for the first time as an adult are seldom very graceful. When the first example of the new order of things arrived, we were agreeably surprised; we were of course able to touch up Dr. Gradenwitz's text here and there, but on the whole he did it very well. And he has been doing it better ever since, barring a period when the British Navy wouldn't let him do it at all. We hope that our readers appreciate what it means to us and to them to have affairs in Germany covered in this way by a correspondent who writes in their own language, and not through the medium of an interpreter. Dr. Gradenwitz is our only native correspondent in a foreign-speaking land who writes English; and when we tell you that his product almost always goes before you without any change, without any editing whatever, we think you will agree that he makes an excellent job of it.

ONE of our trying tasks is keeping all our stories down to the essentials, in order that we may have space for all the stories that it is necessary for us to cover. That this involves much skilful rewriting is evident. Less evident is the fact that it involves giving thought to other things than the text alone. It is surprising how much space is wasted in commercial and news photography—how much useless background and foreground and sides are included in a given photograph. Thus, if the photographer is making a picture of an oil can, he is as apt as not to include the entire automobile engine or lathe or other piece of machinery that may be oiled. Yet the whole story is in the oil can, and just so long as there is a sufficient portion of the engine, lathe, or machinery shown to carry out the idea, it is not necessary to show very much of the useless trimmings, so to speak. A whole oil can need not be shown, for that is useless in the extreme. If we show the entire oil can, the cut or printing plate must be made of a very large size in order that the "meat" of the picture—namely, the oil can, will be sufficiently large to show what it is. And if we give so much space to a mere oil can, how can we ever cover our wide editorial scope? So it comes right down to a matter of trimming photographs—cropping them, as the parlance of the magazine shop and engraving shop has it. We trim off the useless foreground, the useless background, the useless sides, and so on, leaving the very heart of the photograph. If artistic merit is sought, then some of these otherwise useless trimmings may be left on. Often that dainty hand which you see on our inventions pages, holding a new dish mop, may be that of a beautiful girl, and much as we would like to include all of the beautiful girl on the 8x10-inch print, we feel compelled to crop off all but her hand—a mere two-inch square. Other times, however, it may not be the hand of a beautiful girl, hence the loss is trifling. But in all events this business of cropping is a very necessary one in gaining brevity, condensed pictorial treatment, and the greatest possible diversity in our columns.

FOR a long while back we have been fully cognizant of the many advantages of the motion picture technique over the written or spoken word, by way of reporting a given happening or explaining some new or old phase of science. The motion picture appeals to the mind directly through the eye. For that matter, so does the written word, which makes it superior to that extent over the spoken word. In addition, the motion picture creates the images; it speaks in pictures; it leaves nothing to the mind to create. Its explanations take the form of a succession of animated pictures or cartoons or models. The human eye sees those successive images, notes the changes or development or process, and the mind immediately grasps the full meaning of all these things with the least amount of effort. To explain the operation of a radio receiving set, step by step, by means of the written word, aided with photographs and drawings, is no simple matter, and it may be considerably more difficult for the lay reader to follow and grasp the full meaning of what is written and illustrated. Yet the same story, when told on the screen, is so much simpler. Animation is supplied to the drawings and photographs, and such titles are inserted as aid in explaining certain parts of the story.

MANY SCIENTIFIC AMERICAN stories can well be re-told in motion picture form, for the reason that they require animation for a more ready understanding by the laity. To this end we have entered the motion picture field, as producers of SCIENTIFIC AMERICAN films, in collaboration with the Coronet Films Corporation of Providence, R. I. The films, which will appear once a month, will be released through the Education Film Exchanges, and will be shown in the better-class theaters throughout the country. Such subjects as can be treated to the best advantage in motion picture form will be taken from our columns and transplanted to the screen. The complete details will be covered in these columns; the thing itself will be featured on the screen, under the SCIENTIFIC AMERICAN title.

ANOTHER piece of news! We have inaugurated a special radio-phone broadcasting talk of our own in order that we might report and comment on the scientific news of the day for the benefit of the radio audience. For the present, our activities are centered in the Middle Atlantic States, but in the very near future we shall make arrangements to cover more or less the entire country with our radio talks. We are using the WJZ station of the Radio Corporation-Westinghouse organizations, located at Newark, N. J., for our present broadcasting, thus covering a range of several hundred miles. If you are within reasonable range of WJZ, you can tune in to 360-meter wave length and listen in to the SCIENTIFIC AMERICAN radio-phone talks between 9 and 10:15 on Friday, May 19th, Tuesday, the 23rd, Wednesday, the 31st, and every Wednesday thereafter. Let us hear from you if you receive our radio-phone talks, whether you are far or near. Also send us suggestions as to what you would be interested in, and we shall endeavor to mold our radio talks accordingly.

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SEVENTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JUNE, 1922

United States Great Britain France Belgium Germany China Japan Italy Spain

How the wages of the building trades in the several countries compare, when reduced to gold. The number of "coins" in each man's stack is directly proportional to his daily wage, the exact amount of which will be found in the text

The World's Wages—a Statistical Anomaly

STATISTICS sometimes are of the most absurdly misleading nature. We thought it would be interesting to make a comparison showing how much labor an ounce of gold would buy in the various countries. It looked simple: the comparison visualized itself and the article fairly ran out of the typewriter. It was only necessary to order up a couple of hundred pounds of Government documents, digest them, and the figures would marshal themselves in orderly rows and columns. But when we did it the results were so extraordinary that we thought our statistical hand had lost its cunning. We are never too proud to seek advice when puzzled, but expert advice only thickened the fog. An appeal was taken to a great Government authority. We omit his name because we promised to, but we quote his reply in extenso.

"If I were not a superman (which, of course, I am), I would be glad to know that somebody else has found out what a delightful thing it is to handle the statistical side of international economic questions at this particular time. I fully understand your amazement at finding the wages of painters less in Germany than in China. Apparently you do not believe it; neither do I. But mathematically and statistically it is correct if the fundamental basis is correct. The first Commissioner of Labor, Carroll D. Wright, undertook an investigation of criminality of cities by nationality. The final returns showed the Chinese in the District of Columbia to be 300 per cent criminal! Naturally, Colonel Wright wanted to know what idiotic clerk had worked out such a proposition as that. He was told by his chief statistician that the statement was statistically correct; that there was one Chinese in the district and that he had been arrested three times.

"If we apply the price that New York is willing to pay in American gold for the German mark, your figures are correct. The basic fallacy lies in trying to express wages and prices in a country undergoing a financial upheaval like that in Germany today, in terms of the money of another country. I think it true that in Germany today, on the basis of the American dollar, a painter is working for 25 cents a day; but in Germany today they are not buying or using gold—so why measure their prices in gold? To do so manifestly distorts the situation. With existing conditions in Germany, Italy, even Belgium, I think this explanation holds; that to express conditions there in terms of our money, which they are not using, is essentially misleading. But after all I may be wrong—you asked me for my opinion and here it is: personally, not officially."

Notwithstanding this criticism, we shall go right ahead and present the information we acquired so painfully. Our foreign exchange quotations are those of February 25. On that date the British pound was worth $4.41 in gold; the French franc, 9.08 cents; the Belgian franc, 8.64 cents; the Italian lire, 5.17 cents; the German mark, 4.5 mils. The less said about the Russian ruble the better; its value depends on that of paper and ink. In the Far East we have the Japanese yen, which is fairly stable, 2 or 3 cents below its par value of 49.8 cents.

In some of the figures there are gaps, probably because the trade is so lightly represented that nobody has ever troubled to compile statistics. For farm laborers the figures are necessarily more of a guess than for better organized and better standardized trades. With these safeguards we present the figures for five ordinary vocations.

The question at once suggests itself: what is a "day?" Here again we strike a snag, and can only say that the hours vary from eight to ten, depending on the usages and on the strength of the unions, if these exist.

(Continued on page 436)

Spain Italy Japan Germany Belgium France Great Britain United States

A similar comparison for the agricultural laborer. The stacks here are to be compared only with one another, and not with those of the upper strip, the German's wage having been taken as the unit in each case, and being different in the two branches

The North Atlantic Ice Patrol

How the Coast Guard Cutters Broadcast the Position of Icebergs to Shipping

THANKS to the ceaseless vigilance of the cutters of the United States Coast Guard, the recurrence of such a stupendous disaster as the loss of the "Titanic" through collision with an iceberg, is a very remote possibility. It could only happen, indeed, through failure to pay close attention to the warnings of the ice patrol and practice quick compliance with its suggestions.

The loss of the "Titanic" was bound to result in efforts to provide against any similar disaster, and the many investigations which followed were directed to two separate fields of inquiry. First, there was the peril which lay in the faults of construction of the ship itself, faults which were common in all shipping of that day; and secondly there was the peril of the uncharted iceberg, floating down from the north across the lines of steamship travel. The first peril was met by the organization of the International Bulkhead Commission, whose findings resulted in a closer spacing of bulkheads and various improvements aimed to protect the stability of ships by limiting the inflow of water in case of under-water damage. Something was gained in this direction, but we could wish that the structural safety provisions had been carried further in the direction of raising the height of the bulkhead deck, and the insistence that it should be made watertight.

The recognition of the peril from floating icebergs led to a request by the maritime nations that the United States undertake the patrol of the ice-infested regions during the three months of the year—April, May, and June—which covers the southward passage of the ice. No time was lost in instituting this patrol, and the work was relegated to the Revenue-Cutter Service, now known as the Coast Guard, the other nations agreeing to pay a pro rata share of the cost of the service.

The Revenue-Cutter (Coast Guard) is very proud of its long history and its honorable traditions. It was established by an Act of Congress, approved August 4, 1790, and ten vessels were built and placed in commission by November 1, 1791. It is a curious fact that this constituted the only armed force of the United States afloat, thereafter, for a period of more than six years, or until the commissioning of certain vessels of our newly organized navy. The Coast Guard is organized as a military service. It has an academy at New London, Conn., for training and instruction of cadets; and warrant officers are drawn from the enlisted force, by selection for fitness and general qualifications. The equipment consists of thirty-one cruising cutters, including five "Eagle Boats" of doubtful value, twenty-five harbor cutters, twenty-two launches, and two hundred and seventy-three Coastal and Great Lakes Stations. Also, the Service owns eighty-five self-bailing, self-righting life boats, driven by gas and sail; three hundred and eighty self-bailing surf boats, driven by gas and oars; and five hundred and thirty boats of other types.

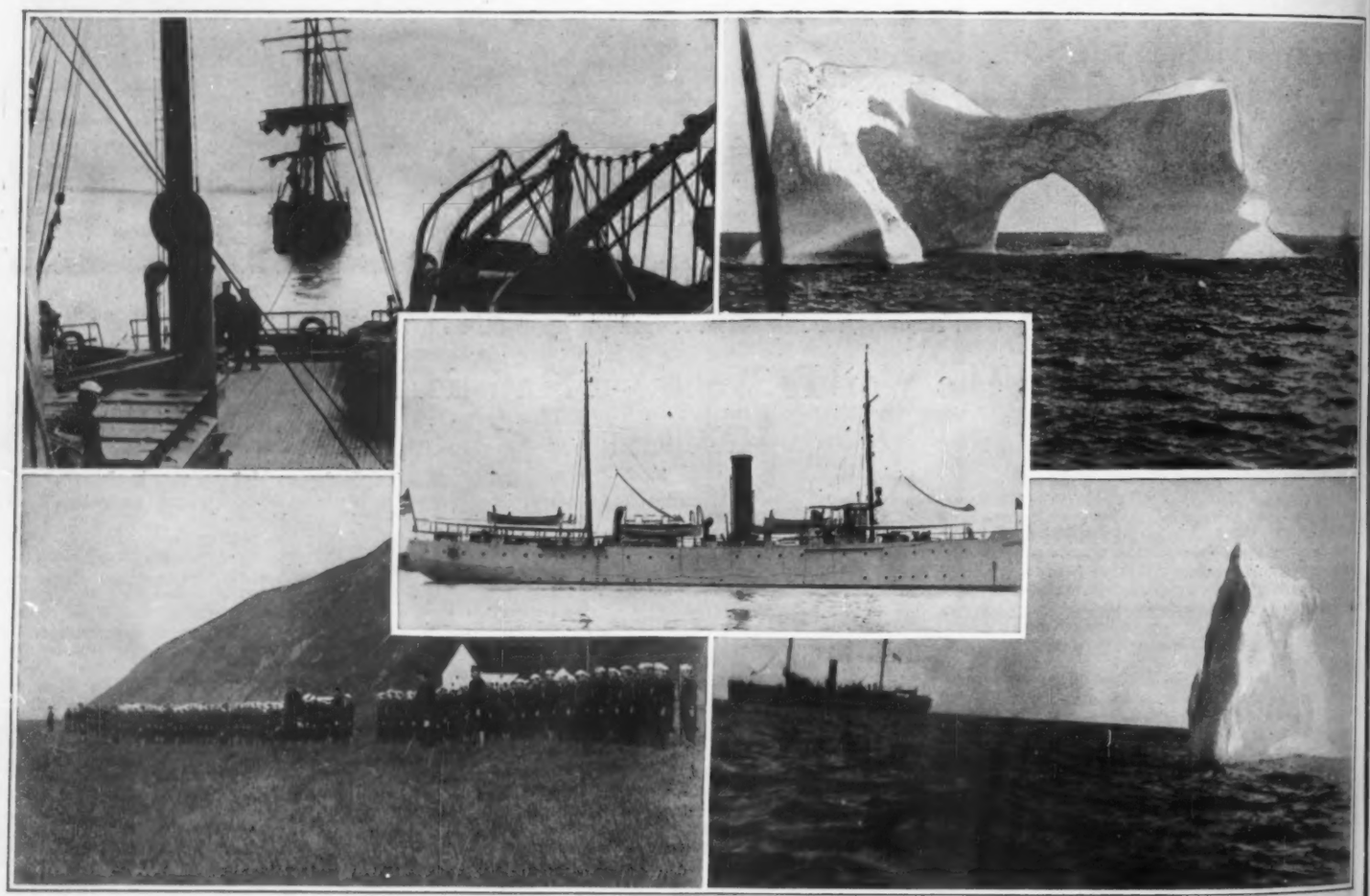
The duties of the service are many, including assisting vessels in distress; destruction or removal of derelicts; protection of customs revenue; regulating the anchorage of vessels in navigable waters; enforcing quarantine and neutrality; suppression of mutinies; enforcing navigation laws covering merchant vessels and motor boats; protection of the seal fisheries; patrol of western rivers for rescue of life and property during floods; and finally the patrol of the Grand Banks off Newfoundland for the protection of shipping from ice fields and bergs.

It is a very active service, as may be seen from the report for the year ended June 30, 1917, covering the last of the pre-war activities, and the months of the war between April 6th and June 30th of that year. During that time 2153 lives were saved, or persons rescued, and 13,796 persons on board vessels were assisted; 11 derelicts were removed or destroyed, and the value of the vessels assisted, including cargoes, was $14,960,910.00. It should be mentioned that in the one item alone of marine property saved, the service returned in that year $2.38 for every dollar expended for its maintenance.

We question if in any service is to be found higher quality, whether above or below decks, on the bridge or in the engine room, than for many years has marked the Revenue-Cutter or Coast Guard Service. The personnel, because of the frequent life-saving and ship-salvaging work which it has to do, is marked by the careful selection of the enlisted men, of whom it is required that they shall be of good physique, and that they shall be every inch "sailormen." It is probable that in no service is there to be found, today, so much of the real old seamanship, particularly in the handling of boats in heavy weather, and in landing, whether alongside a disabled vessel or on a storm-beaten coast.

The Coast Guard fleet has recently been improved and increased by the addition of four fine vessels, the cutters "Tampa," "Haida," "Mojave," and "Modoc;" and judging from our illustration of the "Tampa," the first of these to go into commission, they are all very shapely craft, with a handsome sheer, good freeboard, and a well-designed midship deckhouse and bridge structure, which with its tumblehome (if we may use the term), harmonizes agreeably with the general ship's structure.

The most novel feature of this ship is that she is equipped with the electric drive. The dimensions of the "Tampa" are length overall 240 ft., breadth 30 ft., and mean draft 14 ft. 3 in. She is driven by a General Electric, Curtis-type turbine. This is direct-connected to a main generator of the alternating current type. The main motor, of the synchronous type, drives a single



Upper left: **Coast Guard Cutter towing a sailing ship out of a sea of dangerous ice.** *Upper right:* **A berg melting and breaking up off the Grand Banks.** *Center:* **The "Androscoggin," Coast Guard cutter from whose deck these photographs were taken.** *Lower left:* **Now and then the crew of the cutters land on some bleak northern coast to drill and stretch their legs.** *Lower right:* **A berg with cutter "Maine" keeping in touch and broadcasting its position to Atlantic shipping**

thirteen-foot propeller. The speed of the "Tampa" when loaded is sixteen knots; and since maneuvering ability is of prime importance in a Coast Guard cutter, it should be noted that by the reversal of her motor she can be brought to a dead stop within her own length, or within less than two hundred and fifty feet.

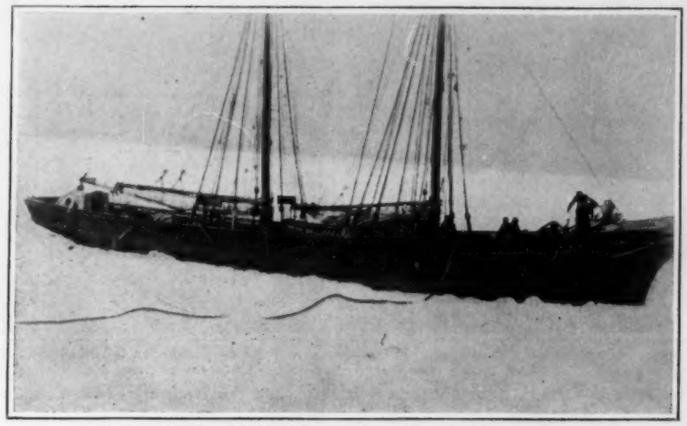
The west coast of Greenland is the birthplace of the justly dreaded icebergs. This great peninsula is almost completely covered with a heavy ice-cap, and, bearing in mind that there is little or no melting from the snows in the high latitudes, the accumulation from the annual snow fall is very large. This mass, compacted to the consistency of ice and following the lines of least resistance, flows steadily down the valleys to the sea. Here the glacier, frequently many hundreds of feet in vertical thickness, protrudes out into the waters until it breaks off by its own weight, and floats wherever the currents and the winds may carry it. For one-ninth of its bulk exposed, eight-ninths lie below the surface of the water. Ultimately these bergs reach the great Labrador current, and their movement is as shown in our illustrations. They travel at a rate which varies from 0.3 knot per hour, in the early spring, to 0.7 knot per hour later in the season.

To anyone blessed with imagination, this grand procession of icebergs, through a distance of over two thousand miles, from the region of Smith Sound, in latitude 78° north, to the Southerly Tail of the Great Bank of Newfoundland, in latitude 43° north, presents a most majestic and wonderful phenomenon.

Were it not for the existence and persistence of the warm waters of the Gulf Stream, the peril of ice in the late spring and early summer would be much greater than it is. This stream passes out of the Gulf chiefly by way of the Straits of Florida, and flows in a N.N.E. course to Cape Hatteras, which it passes at a distance of about twenty miles. Thence its general course is E.N.E., and it widens out, passing to the south of the Great Bank of Newfoundland, where it meets the cold waters of the Labrador current above mentioned. From the Great Banks it broadens out to lose itself finally on the northwestern coast of Europe, whose climate it very materially affects.

By a study of the accompanying map, it will be seen that, after passing down the coast of Labrador, the icebergs are deflected by the great shoal known as the Newfoundland Bank, and pass in a general southerly direction along its easterly contour. Not all of them, however; for some ground upon the Laborador coast, and others upon the northern slopes of the Great Bank. Those which are not caught and anchored in this way continue down to the Tail of the Bank, and it is these bergs that constitute the grave peril to shipping; for once they have passed the Bank, they float out into the steamship lanes, where, in waters that are most of the time covered with more or less dense fog, they constitute a terrible and ever present menace.

The movement of the icebergs after reaching the Tail of the Bank, is, generally speaking, as follows: They are carried south until they encounter the warm water of the Gulf Stream, when they are rapidly turned back to the northeast. They may return in a back eddy later in the season, or they may be carried north, and there frozen with the salt water ice, to go south again as early arrivals the following year. As a general rule they "cave" and split into smaller bergs, and melt rapidly in the Gulf Stream waters. We present a chart published by the Hydrographic office showing the actual course taken by a large berg sighted by the ice patrol four different times during the single month of April, 1921. The office states that this berg was unmistakably identified by photographs taken from the Coast Guard patrol ships, and by other means, and its track accurately computed and plotted. The Bureau requests that navigators make a careful study of this chart, since the drift is typical of the majority of icebergs in the North Atlantic, near the steamship tracks. The oval track drawn to the left of the second sketch of the berg, shows the route of another berg to the southwestward of the Great Bank, in the period of May 20 to June 4, 1921. Its track measured 150 miles across its greatest dimension, and the drift indicates the existence at that time of one of the typical ocean eddies which are to be found in that locality, and which never maintain the same size, boundaries, or positions.



Cutter "Androscoggin" found this schooner fast in the ice

The co-operation of the patrol vessels of the Coast Guard and the Hydrographic Office during the eight years of the Ice Patrol has resulted in the accumulation of a large amount of data respecting the course followed by the icebergs, and the limits of their southerly drift across the steamship lines. As the information is received it is made public in the weekly Hydrographic Bulletin and in the monthly Pilot Charts. Also, the ice conditions are regularly broadcasted by wireless, both from shore stations and from the ships on patrol in the ice-infested waters. The boundary line between the Labrador current and the Gulf Stream is very variable, and on May 15, 1920, it was found to be 70 miles south of the position of the boundary line on May 5, 1914, and over 150 miles south of its position at about the same time in 1913. The thrusting of the Gulf Stream to the southward involves, of course, a more southerly course of the icebergs, and with a view to minimizing the risk to Trans-Atlantic shipping, the Hydrographic office has made arrangements with the steamship companies by which, upon notification from the office, the headquarters of the companies in New York immediately notify the ship captains to follow a steamship track during the ice season of April, May, and June, 150 miles to the south of the normal tracks.

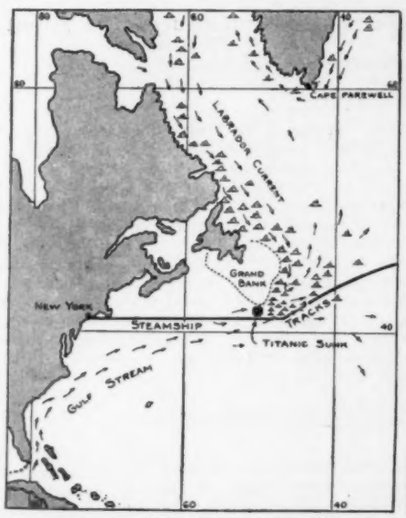
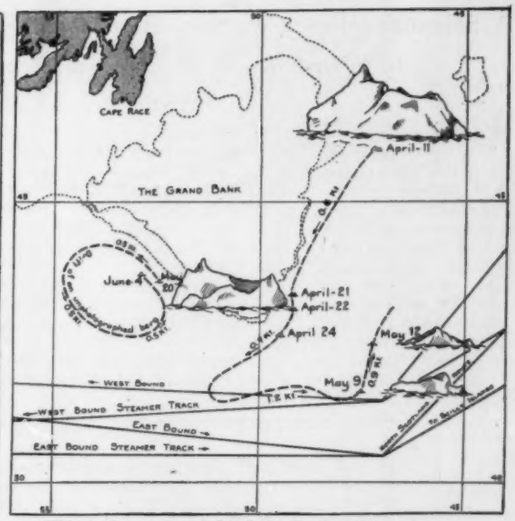


Chart showing icebergs carried by Labrador current into steamship tracks



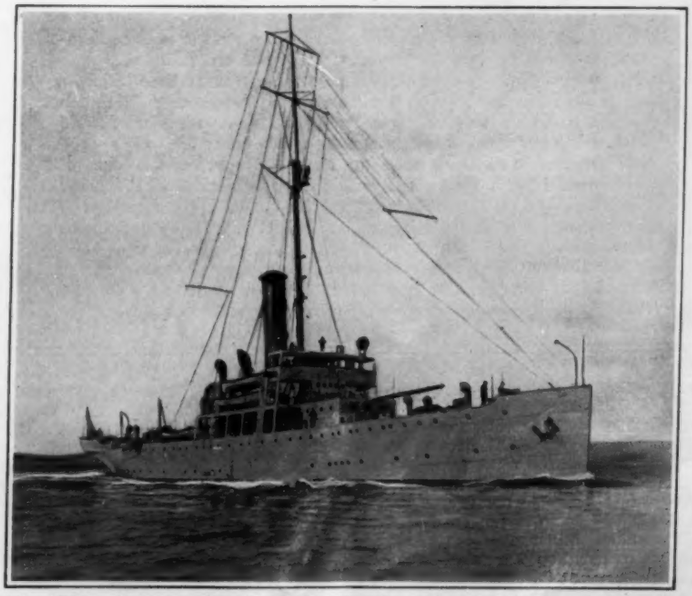
This iceberg was sighted April 11 and its course plotted until May 12, when it disappeared

The records of the Hydrographic office show that during 1921 there were at times as many as ten bergs scattered along the line dividing the cold waters of the Labrador current from the warm waters of the Gulf Stream. Sometimes freak bergs, or "sailors," acted upon by the prevailing winds from the north, will drift down across the Gulf Stream. As a matter of fact it is recorded that icebergs have been sighted as far south as the Azores and the Chesapeake Capes. This, however, is a rare occurrence. In the majority of cases, when a berg enters the Gulf Stream it rapidly breaks up and disappears. During the present season of 1922 the patrol is being carried on by two of the new electrically driven coast guard cutters, the "Tampa" and the "Modoc," which relieve each other at fortnightly intervals. The temporary home port is Halifax, and each ship spends seven days on patrol, and seven days on the journey in and out to this station and in that port, refueling and taking on new supplies.

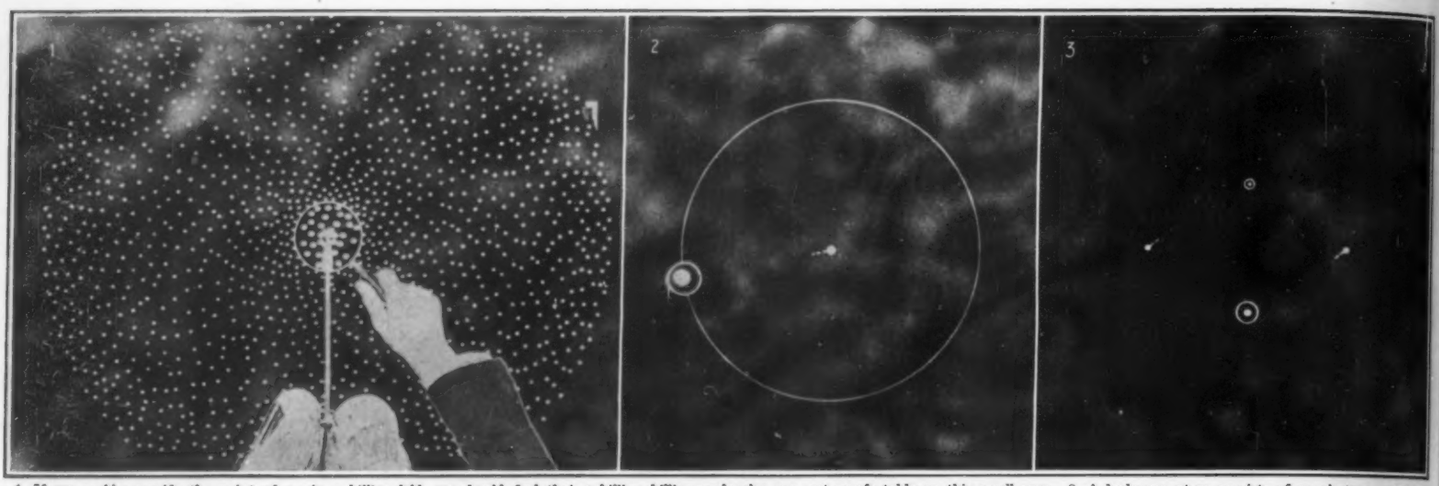
We have before us extracts from the logs of some of the patrol vessels, which show that this service is no summer picnic. Much of the time is passed in dense fog and fierce gales, which frequently necessitate heaving to. Here are some notes from the log of the "Tallapoosa," as written down during her cruise May 15 to 30, 1919, and embodied in the report of the commanding officer:—

"Ice warnings were broadcasted daily at specific times, beginning May 15th, with a

(Continued on page 436)



The "Tampa," one of four Coast Guard cutters of a new type, equipped with the electric drive. Length is 240 feet; speed 16 knots. She is now engaged on the Ice Patrol off the Grand Banks



1. If we could magnify the point of a pin a billion-fold, we should find that a billion billion molecules can rest comfortably on this small area. 2. A hydrogen atom consists of an electron rotating about a positive charge (the nucleus). 3. A hydrogen molecule is formed by the combination of two atoms. The electrons rotate about an axis joining the nuclei, and are shown in perspective

How the simplest molecule is formed, something about its size, and the structure of the atoms of which it is built

Beyond the Microscope

A Scientific Motion Picture Film That Depicts the Structure of the Atom

By S. Dushman, Ph.D., Research Laboratory, General Electric Co.

Contributing Editor, SCIENTIFIC AMERICAN

WE intend to discuss in this article some of the interesting features of the new views regarding atoms and to illustrate the discussion with still pictures taken from the film referred to in the Editor's note.

Of course, as most people know, we cannot see an atom. With even an extremely powerful microscope the smallest particles we can see are at least one thousand times larger in diameter than even the largest of molecules.

Yet we are just as certain of the existence of molecules and the atoms, of which molecules are made up, as we are of the existence in each of our bodies of certain organs, although we have never seen them. In both cases, the evidence is what is known in law as circumstantial; and, for lack of space, we shall take it for granted that all matter consists of molecules and atoms.

We know a great deal about these atoms and molecules. Thus the smallest drop of water (about 1/20 cubic centimeter) contains so many molecules that if these were each enlarged to the size of grains of sand capable of passing through a 100-mesh sieve, they would form a roadway from New York to San Francisco approximately half a mile in width and one foot in height. The molecules are so small that, as shown in Fig. 1, one billion billion could rest comfortably on the point of a pin, 1 mil in diameter.

Or perhaps the best figure is that employed by Aston in his recent popular lectures. Suppose we had means of separating out the individual molecules in a glass of water and labeling them so that we might recognize them again. Suppose then we emptied the glass into the oceans; after millions of years had elapsed to mix the water from our tumbler thoroughly and uniformly with that of the seven seas, suppose we came back and took at random a fresh glass of water from the ocean—we would find in it no less than 1,000 of our labeled molecules. That is to say, the glass of water is to the individual molecule as the combined oceans of a thousand globes like the earth would be to the glass of water.

It is difficult to imagine that such a small particle can have a structure of its own. In fact, the word "atom" is derived from a Greek word signifying "indivisible," but while we still adhere to the term atom, we must, in the light of present knowledge, forget about the indivisibility. But we have all kinds of evidence that the atom is made up of still smaller particles which are nothing else than positive and negative electric charges. Since matter, under ordinary conditions, is electrically neutral, the numbers of positive and negative charges in any one atom are equal, but the actual number of each kind of charge differs from one kind of atom to another. The atom of hydrogen has the simplest structure of all. As shown in Fig. 2, it consists of a single negative charge, or electron, as it is designated, which rotates around the positive charge or nucleus. The electron itself is probably about a thousand times smaller in diameter than the atom. Its mass is about 2,000 times smaller than that of the atom.

Since a billion billion atoms of hydrogen more or less would hardly be noticed on the most sensitive balance, this means that the mass of the electron is indeed very small.

It follows that practically the whole mass of the atom is concentrated at the nucleus. Yet this nucleus is at least 100,000 times smaller in diameter than the atom.

The electron constitutes the ultimate unit of electric charge. Electrons streaming through a conductor constitute what we measure as electric current. Prof. R. A. Millikan has measured accurately the charge carried by an electron; when, for instance, a 40-watt lamp is run on a 120-watt circuit, there are 2 billion billion electrons passing into the filament, per second, at one lead and the same number leaving it, per second, at the other lead.

The hydrogen atom consisting of a single electron rotating around a positive nucleus of unit charge has a fairly large stray field of force around it. Consequently two atoms of hydrogen combine very readily to form the hydrogen molecule, shown in Fig. 3. The electrons now rotate around an axis formed by the line joining the two nuclei.

Hydrogen is the lightest of all elements. As we pass to the other elements, we find that the number of positive charges on the nucleus, and consequently the number of electrons around the nucleus, increase regularly. Each element can be thought of as being built up from the element just below it by the addition of one electron and one positive charge on the nucleus. Thus helium consists of two electrons and a nucleus of two unit charges; lithium has three electrons and a nucleus of three unit charges, and so forth. The heaviest atom known, that of uranium, has 92 electrons and a positive charge on the nucleus of 92 units. The most recent theory regarding the arrangement of these electrons around the nucleus in the different atoms, is that suggested by Dr. Langmuir, This theory, which is a development of some earlier speculations of Prof. G. N. Lewis of the University of Berkeley, California, postulates that the electrons are arranged in shells with the nucleus as center and that arrangements of two and eight electrons are extremely stable. In the simplest atoms, those of the hydrogen and helium, there is only one shell. With the addition of a third electron, a new shell begins to form. This shell is completed when it contains eight electrons, which may be considered as located at the corners of a cube. The atom thus obtained is that of neon, a gas which has properties quite similar to those of helium. Both are absolutely inert chemically, gases at ordinary temperatures, and very difficult to liquefy, which is in accord with the theory that a shell of eight or one of two electrons is a very stable arrangement. On the other hand, an atom containing less than eight electrons in the second shell is quite active chemically. Thus lithium, with only one electron in the outer shell, is extremely electro-positive, since it tends to give up this extra electron. This leaves only the inner shell of two electrons and a nucleus of three positive units. The arrangement of electrons is thus similar to that obtained in the helium atom. The only difference is that the latter is electrically neutral, while the lithium atom which has one electron removed has a residual positive charge of one unit. It is known as a lithium ion, and is present in aqueous solutions of lithium salts, thus accounting for the electrical conductivity of such solutions.

On the other hand the fluorine atom has one electron and one positive charge less than neon. When fluorine is combined with lithium it completes the external shell

FOR years those elusive and little-understood particles of matter—the molecule, the atom and the electron—have existed to all practical purposes only in research laboratories, surrounded by test tubes, vacuum bottles, and the mathematical formulae of the scientist. When now and again their names have been mentioned in the news dispatches that go before the great public, it has been indicated that they play a large role in the every-day affairs of mankind; but just what this role was, or just what the molecule, the atom and the electron themselves were, has not been made clear to the uninitiated. The need of a wider appreciation of the laws governing the behavior of these infinitesimal realities has increased in proportion to the knowledge which the scientific workers have piled up about them. As a means of bringing about this wider appreciation, the molecule, the atom and the electron have gone into the movies, under the personal conduct of the heads of the General Electric Research Laboratories at Schenectady. "Beyond the Microscope" is the title of a film prepared by C. F. Bateholts of this company, which is the first attempt to portray in a vivid manner some of the prevalent concepts regarding the structure of matter. The story of this film and of the scientific facts and researches behind it is told on these pages by Dr. Dushman, one of those most involved in the laboratory work which preceded its production.—THE EDITOR.

of eight electrons by taking the extra electron from the lithium atom. Fluorine is therefore said to be electro-negative, and the fluorine ion has the same arrangement of electrons as neon, but since it has a nucleus with only seven positive charges, the resultant charge on the ion is negative.

If a solution of LiF (lithium fluoride) is electrolyzed, the positively charged lithium ion goes to the cathode (negative electrode) and the negatively charged fluorine ion goes to the anode.

When one electron is added to the atom of neon, a third shell begins to form. The atom of sodium contains 11 electrons, and, like lithium, is electropositive. As more electrons are added, we obtain less strongly electropositive elements and with 7 electrons in this shell, we obtain the atom of chlorine, which resembles that of fluorine. On the addition of one more electron, we again obtain a stable, chemically inert atom, that of argon.

The fourth and fifth shells contain 18 electrons each. In each case the atom corresponding to the completed shell is that of an inert gas resembling helium, neon and argon. Thus the atom of krypton consists of five shells or layers, and has a total of 2+8+8+18+18=54 electrons.

Fig. 4 shows a model which may be used to illustrate the arrangement of electrons in any of the atoms of the first (that is lightest) 54 elements. It consists of miniature lamps, each of which is connected to a switch shown on the switchboard at the right. The nucleus is indicated by a red light at the center, and different colors on the lamps are used to bring out more sharply the different layers of electrons.

Fig. 4. The atomic model which, by lighting any desired combination of its 54 surrounding lights together with the central lamp representing the nucleus, may be made to serve as a model of any of the 54 simplest atoms

It was obviously impossible to represent on a film the motions of the electrons in these more complex atoms. Moreover we do not know very much about the actual motions of the electrons. The positions of the lamps in the model are to be taken more as indicating average locations than as fixed positions of the electrons. In order to illustrate in the film the mechanism by which compounds are formed, a simpler case was chosen, that of the combination between hydrogen and oxygen to form water. In this reaction an atom of oxygen combines with a molecule of hydrogen.

We have already discussed the structure of the hydrogen molecule. The oxygen atom is illustrated in Fig. 5. The electrons here are arranged in two shells. The inner shell has the structure of helium, that is two electrons near the nucleus. The outer shell has six electrons arranged at the corners of the imaginary cube described already. Altogether there are eight electrons and the nucleus has a positive charge of eight units. It is evident from what has been stated above, that in order to complete the outer shell, two electrons are required. These are furnished by two hydrogen atoms, that is, one molecule of hydrogen. As these electrons enter into the vacant corners of the cube, the nuclei of the hydrogen atoms tend to place themselves symmetrically with respect to two corners. Owing to the attractive forces exerted, the electrons at these corners are pulled in and the cube becomes distorted into the form shown in Fig. 6. In this figure, the nuclei of the two hydrogen atoms and that of the oxygen atoms lie on the axis shown by the dotted line, while the electrons presumably revolve about this axis and also two other axes (indicated by dotted lines) at right angles to that joining the nuclei. Of course, this particular kind of motion of the electrons is hypothetical, but it is quite probable that the electrons are not absolutely stationary.

The transition from this representation of the molecule of water to the more conventional formula Fig. 7 is evident. In electrolysis, one of the hydrogen nuclei tears itself away from the molecule and as hydrogen ion (with unit positive charge) travels toward the cathode, while the residual part of the molecule, as negatively charged —OH ion, travels toward the anode.

When water is evaporated, we obtain steam. The molecules which were quite crowded together in the former case are now separated by fairly large distances, and their continual impacts on the walls of the vessel produce the effect of pressure.

In water itself, the molecules are quite mobile, but when water freezes to form ice or snow, we find these molecules assume regular crystalline arrangements and the most beautiful creations in nature are those which are exhibited by snow flakes.

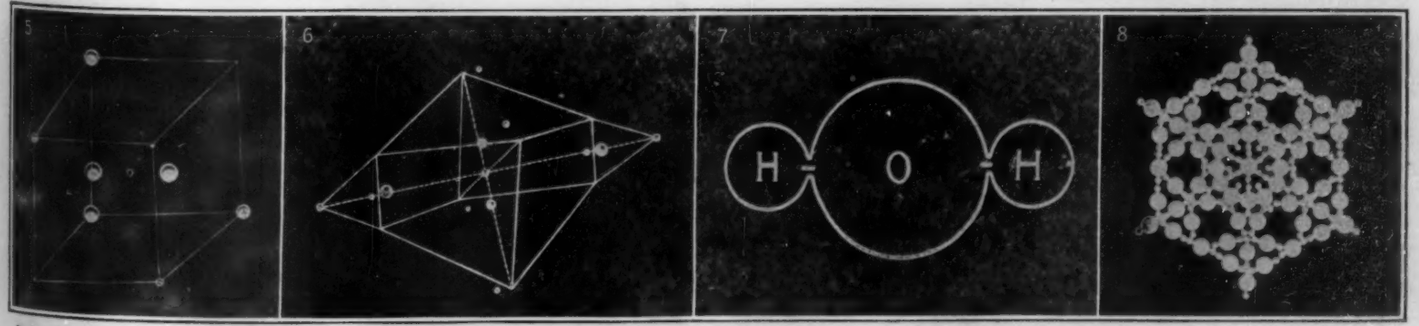
It is unfortunate that we cannot reproduce on the printed page the actual motion of the film. We believe that we have made as advantageous as possible a selection of our stills; but no set of stills ever does full justice to a film. The film, made on the animated cartoon principle, gives a startlingly vivid representation of the behavior and the constitution of two of the simplest atoms. To attempt to represent in a similar manner the motions of electrons in some of the more complex atoms and the manner in which these atoms combine to form compounds would, indeed, be quite a task for even the motion-picture artist.

Bat Guano in Austria

MUCH interest has been aroused in Austrian agricultural circles by the discovery that many of the hundreds of caverns found in the Austrian Alps contain valuable deposits of bat guano and other phosphates of animal origin. The government has passed a law retaining these under the control of the state and has been having official analyses of the deposits made and experiments as to the best method of preparing them for use as fertilizers. It has already been officially estimated that the Cave of the Dragon in Styria is capable of yielding 50,000 tons of granular phosphate of very homogeneous character; this contains 41 per cent of phosphate of lime, 25 per cent of carbonate of lime, and 34 per cent of readily attackable silicates. These fertilizers are now being systematically distributed in the different parts of Austria, to be used in replacing bone dust, etc.

New Studies of Caries in Teeth

THE alarming prevalence of caries in the teeth of civilized nations is a matter of universal concern. Some new and rather surprising light is thrown upon this subject by recent investigations conducted in the laboratory of the hygienic institute of the University of Leipzig. Perfectly sound teeth taken from various individuals between the ages of 18 and 55 years were employed in the experiments. Not the slightest flaw was to be found in any of these, not even with a magnifying glass. For the purpose of the experiment each tooth was covered with a layer of wax, in which apertures were then made at one point or another, after which the tooth was immersed in a mixture of bread and saliva, at a temperature of 37 degrees Centigrade. At the end of a week half of this mixture was removed and replaced by a fresh mixture of the same sort, in order that the conditions usually present in the mouth, of a mixture of fresh food and saliva, together with decomposition products of former mixtures, might be reproduced as closely as possible. The first traces of caries became manifest in a deeply grooved incisor; softening and discoloration was shown in this tooth even after the lapse of 33 days. At the end of 56 days all the other teeth exhibited signs of softening, while completely developed caries was exhibited in all at the end of 124 days. The caries was produced at the selected points, whether these were covered with enamel or were at the "neck" of the tooth. According to Professor A. Seitz, who discusses the matter in the *Münchener medizinischen Wochenschrift*, the caries produced in this artificial manner is precisely like natural caries, showing all the stages thereof. Strange to say, however, the common belief that marmalades and similar sweets are largely responsible for the spread of caries was not confirmed: "While mixtures of bread, saliva and marmalade produced caries in about the same length of time as the first mixture (of bread and saliva alone), teeth placed in mixtures consisting only of marmalade and saliva showed no alteration even at the end of 61 days. It appears, therefore, that both the preformed acids and the traces of natural fruit acids of the marmalade are without effect in the production of caries."—*Abstracted from Die Umschau.*



5. An oxygen atom, with its eight electrons. Two of these are quite close to the central nucleus, while the other six are at corners of an imaginary cube. Two of these corners are blank, and the atom enters into chemical combination with other atoms by allowing electrons of these atoms to fit into the empty places. 6. Formation of water from two hydrogen and one oxygen atoms, as described in detail in the text. 7. The conventional symbol for the molecule of water, indicating its structure of hydrogen and oxygen atoms. 8. A typical snowflake, showing how the beautiful crystal structure is pieced together by appropriate arrangement of molecules

Further stills selected from the motion-picture story of the atom

Three views of the Goldschmidt amphibious train as it appears in the water and on rails. The left-hand view shows the train on the inclined rail, entering the water. The center and the right-hand views show the train on the monorail

By Rail and By Water

The Combination Train and Tow Barges Invented by a Belgian Engineer for Use in the Congo

NATURE has little consideration for commerce. Thus, as often as not, we find tremendous stores of natural wealth tucked away in some remote and inaccessible corner of the world, where they must lie until a more fortunate day, when the problem of transportation is solved, or again until other stores of similar materials nearer to the markets are exhausted.

A most striking case in point is the Belgian Congo, in darkest Africa. Here are to be found rubber, rare fruits, metals, nuts, and so on, all of which have a ready sale in the markets of the world. But these stores of natural wealth are located far up the Congo River which, although navigable in stretches, has many rapids and other barriers to navigation on anything like a commercial scale. Such railroads as exist in this far off land are of little consequence, not only as regards the territories which they serve, but more particularly in their mechanical limitations. In sparsely settled regions such as the Belgian Congo there is no doubt but that water transportation must always be cheaper and better than the railroad; but how can we navigate a river that is broken up into separate navigable stretches of water, with rapids, swamps, flats, and rocks intervening?

Two methods of solving the Congo transportation problem and releasing the natural wealth for the benefit of the entire world have presented themselves in the past. The first is to undertake the gigantic engineering task of making the river navigable from the Atlantic Ocean to the regions containing the natural wealth in question. Boats of at least 600 tons would have to be accommodated by the river in order to make commercial transportation profitable. An English engineer, Wall, who has carried out numerous large engineering undertakings in South Africa, has suggested a plan for rendering the river continuously navigable between Matadi and Leopoldville. This plan calls for the cutting of a number of canals at certain points, these canals being provided with inclined railways for raising the boats out of the water, carrying them over the land, and lowering them back into the water again on the farther side. Another feature of the enterprise would be certain changes in the river bottom, involving among other things the removal of over 1,300,000 cubic yards of rock. All in all, the proportion of navigable sections as against unnavigable sections is nine to one, and the cost of bringing about continuous navigation is well out of the question at this time.

The second method that has presented itself is to leave the river as it is and to develop some form of combination water-and-land transport. To make this scheme practical, it is necessary, of course, to load the carriers at some interior point and then carry the cargoes all the way to the point of reshipment for Europe.

And thus we arrive at the ingenious system of combination water-and-rail transportation developed by Robert B. Goldschmidt of the University of Brussels, in Belgium. In collaboration with another engineer by the name of Vanderhaegen, Mr. Goldschmidt has succeeded in constructing a veritable train, which is as much at home in the water as it is on land, and which passes from the water stage to the railroad stage with no other change than the shifting of the gears of the power plant. The first unit serves as the tractor, while the other units are trailers.

View aboard the Goldschmidt amphibious train, showing one of the holds and the center connecting structure which carries the wheels

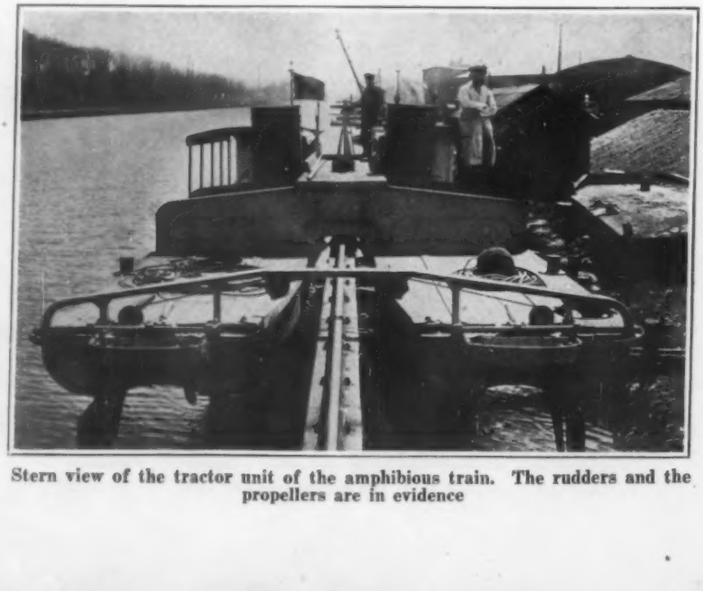
So much for the general details. Each unit of this amphibious train consists of two boats or boat-like bodies, connected together in the manner indicated in the accompanying illustrations. The four members connecting the twin boats together also carry the wheels which engage with the monorail track when the amphibious train is traveling over land. Each boat is about 38 feet long and about 6 feet wide, and can carry 11 tons, while the shallow draft permits of navigation in shoal waters.

Now the tractor unit of this unusual train is equipped with a 300-horsepower plant, capable of hauling 5 to 10 trailers, with a total carrying capacity of 220 tons at a speed of 6 miles per hour.

The construction of these twin boats is such that they have remarkable stability in water. The unequal loading of the two boats of a given unit is said to make very little difference; indeed, one boat can be loaded to its full capacity while the other may be empty, without serious results. When the train comes to the land stage of its travel, it simply straddles the monorail that comes down into the water, and then, under its own power, climbs out of the water, as dramatically shown in our cover illustration. The monorail extending down into the water has a very easy grade, not more than 3 per cent; so that the amphibious train can readily negotiate it with a heavy load.

The same power plant is used for marine and land transportation. The two gasoline engines, of 150 horsepower each, are readily shifted over to the four motor wheels which ride on the monorail. At this phase of the journey the problem of equilibrium between the two boats of a unit assumes greater importance. To the end of securing the utmost stability, the wheels have been placed well above the bottoms of the boats, as will be noted. Thus, if one boat is loaded with 10 tons and the other with 9 tons, or a difference of 1 ton, the unit will lean to the heavier side to the extent of 7 degrees from the horizontal. The extreme limit of inclination is 13 degrees, at which point the boats are apt to come in contact with the rail supports, especially on curves. However, tanks are provided at the front and rear ends of each boat, in order that water ballast may be employed to balance the boats of a unit. The usual speed on rails is three miles an hour, although higher speeds can be realized with a considerable loss of stability of the train.

The construction of the monorail for the land sections of the amphibious route is simple. It is best, of course, to prepare a roadbed, so to speak, some 12 feet wide, finished off with broken rock or gravel in order to prevent the encroachment of the dense tropical vegetation. In the center of this roadbed or right-of-way are placed a long row of upright posts which support the stringer with its monorail. The construction can be carried out with heavy timber. The beginning and the end of each land section, where the trains pass in and out of the water, are formed by the inclined monorail which goes down into the water. Guides are provided on either side of the monorail, so as to bring the train into the proper position for the engagement of the wheels with the monorail. The train is provided with brakes, which are used when going down an incline and into the water.



Stern view of the tractor unit of the amphibious train. The rudders and the propellers are in evidence

Uncle Sam and Radio

Further Developments in the Deliberations of the National Radio Conference and Future Probabilities

By George H. Dacy

A RECONVENTION of the National Radio Conference is being held at this writing and will continue until all the matters pertaining to radio regulation are reduced to a workable and satisfactory basis. The indications are that the second official meeting of the conference representatives will not last longer than a week or ten days. The recommendations of the original meeting have been discussed extensively and argued pro and con to the point where the chaff has been eliminated and only sound, logical subject matter remains to be offered to the Congressmen who will have charge of framing a proposed new radio law which will be presented to Congress.

If the recommendations of the Conference are legalized, Secretary of Commerce Herbert Hoover will be the director of the ether so far as radio telephony is concerned. The American urchin and the amateur class which is interested keenly in wireless will be adequately protected and served. The demands of the rapidly developing radio art also will be protected in the modern regulations. The new legislation will be extremely flexible, in order, as the occasion for so doing arises, that it may be changed to accord with the rapidly developing radio industry. It is quite probable that, henceforward, the granting of radio licenses will be wholly within the discretion of Secretary Hoover, and that he will also be empowered with the right of revocation in order to eliminate unnecessary stations that are duplicating certain lines of service or in other ways unduly interfering. Potentially, the Secretary of Commerce will have ample power so that he can classify radiophone broadcasting stations, assign bands of wave lengths, and generally eliminate interference of stations of the same class of service with each other and among stations of various classes of service in so far as is possible.

During the interim between the two main sessions of the National Radio Conference, the experts in charge of the radio work in the various Government bureaus including the Departments of Agriculture, Commerce, War, Navy, Post Office, Treasury and State have met together and formulated Government policies. Their cooperative plans and arrangements will receive special official consideration in any new radio regulations which are passed by Congress. Representative Wallace H. White, Jr., of Maine, who has charge of the preparation of the new radio regulations and who will introduce them into Congress, is opposed to any monopolistic radio service which might possibly develop in the future. Recently he said: "We hope that the bill when passed will include a provision that no individual or corporation shall get the vested right in any wave length assigned to that particular class of individual or corporation."

The sentiment of the radio experts who attended Secretary Hoover's initial radio convention was that the radio laws should be amended so as to give the Secretary of Commerce adequate legal authority for the effective control of the establishment of all radio transmitting stations, except amateur, experimental and Governmental stations, and of the operation of non-Governmental radio transmitting stations. The general opinion was that radio communication is a public utility and as such should be regulated and controlled by the Federal Government in the public interest. It was also apparent that the conferees believed that the types of radio apparatus most effective in reducing interference should be made freely available to the public without restriction.

The sense of the conference was that the Secretary of Commerce should assign to each radio telephone broadcasting station a permissible power based on the normal range of the station, such as Government broadcasting stations, 600 miles; public broadcasting stations, 250 miles; private and toll broadcasting stations, 50 miles. In this connection it was recommended that the Bureau of Standards should make a scientific study of the relation between the normal reliable range of a station and the antenna power on the basis of the use of good available receiving apparatus. It is anticipated that this relation will change with the development of the radio art.

Another recommendation was that the same wave (or overlapping bands) be not assigned to stations within the following distances from one another, except that these distances may be lowered if the normal ranges of the stations are correspondingly lowered: for Government broadcasting stations, 1500 miles; for public broadcasting stations, 750 miles; and for private and toll broadcasting stations, 150 miles. It was also suggested that the Bureau of Standards should make a study of the width of wave band required for satisfactory radio telephony. It is generally recognized that this width depends on the methods of transmission and reception employed.

As a result of the intermingling of expert radio opinions at the Washington conference, an immediate study will be made by the Department of Commerce of the best geographical distribution of broadcasting stations, with a view to attaining the best service with the minimum of interference. A chart has already been prepared by the national radio experts showing an ideal distribution of broadcasting stations under various assumed conditions as to number of available wave bands and ratio of distance between stations having the same wave length to the normal range of the stations. It was also recommended that in cases where congestion of radio telephone broadcasting traffic exists, or may exist potentially, that the Secretary of Commerce assign suitable hours of operation to existing or proposed private and toll broadcasting projects.

Typical broadcasting studio, showing the microphone on the adjustable and portable stand, which serves to transmit a single voice or a chorus, a single musical instrument or an entire orchestra

The Amateur Committee of the Radio Conference suggested the following recommendations: (1) That the status of the amateur be established by law, (2) That the limit of wave length band allocated to the amateur be specified in the law, (3) That the wave length band allocated to the amateur be from 150 meters to 275 meters, (4) That the Secretary of Commerce subdivide the amateur allocation into small or wave length bands for the various classes of amateur transmitting apparatus, at his discretion but in the following order of wave lengths starting at the shortest wave: spark, interrupted or modulated continuous wave telegraphy, telephony, continuous wave telegraphy, (5) That the amateur continue to be under the jurisdiction of the Department of Commerce, and (6) That for the purposes of self-policing among amateurs, Amateur Deputy Radio Inspectors be created, selected from the amateurs in each locality. The duties of such amateur inspectors will be to cooperate with the District Radio Inspector in the observance of radio communication laws and regulations of the United States and the observance of such local cooperative measures as are decided upon in each community for the minimizing of interference between the various groups of the public interested in radio. These Amateur Deputy Radio Inspectors are to be vested with whatever authority may be necessary in the opinion of the District Radio Inspector.

Another commendable suggestion of the conference was that the Secretary of Commerce at his discretion may prohibit at any time the use of existing radio transmitting apparatus and methods which result in unnecessary interference, provided that such action should not be taken unless more satisfactory apparatus and methods are commercially available at reasonable prices and until an adequate time interval is allowed for the substitution of the more satisfactory apparatus. Subject to public interest and the reasonable requirements of each type of service, the sentiments of the conference were that the order of priority of the service should be Government, public, private and toll. The consensus of opinion was that the priority in the granting of a license, the assignment of waves and permissible power to a private or toll broadcasting service should depend on the amount of public interest associated with such service. It was suggested that toll broadcasting service be permitted to develop naturally under close observation, with the understanding that its character, quality and value to the public should be considered in determining its privileges under future regulations. Furthermore, it was recommended that direct advertising in radio broadcasting service be forbidden and that indirect advertising be limited to a statement of the call letters of the station and of the name of the concern responsible for the matter broadcasted.

In instances where all the available wave bands in any geographical district are assigned, the feeling among the radio specialists was that no further licenses for radio broadcasting in that section be granted until for some reason or other some of the existing licenses are revoked. The policy of the private or toll broadcasting of any but official time signals authorized and approved by the Secretary of Commerce was also deemed objectionable. Another suggestion was that the license requirements for the operator of a radio telephone transmitting station include a knowledge of the International Morse Code sufficient to receive at the rate of not less than ten words a minute.

Among the other outstanding recommendations made by the experts who composed the Radio Conference was the suggestion that the Bureau of Standards make a study of the technical methods for the reduction of interference, giving special attention to: (1) The reduction of the rate of building up of oscillations in radiating systems; (2) The reduction of harmonics in continuous wave transmitters and of irregularities of oscillation; (3) The comparison of the variable amplitude method with the variable frequency method of continuous wave telegraphy; (4) The preferable methods of telephone modulation to avoid changes in the frequency of oscillation; (5) The proper circuit arrangement of regenerative receivers to avoid radiation of energy; (6) The use of highly selective receiving apparatus, including a list of approved forms; (7) The use of receiving coil aerials instead of antennæ, with special reference to high selectivity; (8) The reduction of interference with radio communication of other electrical processes, such as the operation of X-ray apparatus and electrical precipitation, and (9) The study and standardization of wave meters.

The developments of radio telephony are being carefully followed and the reader may rest assured that we shall report all happenings of importance, just as rapidly as we can get them into print. The next issue will probably contain the final decisions of the National Radio Conference.

The Gentle Art of Radio Broadcasting

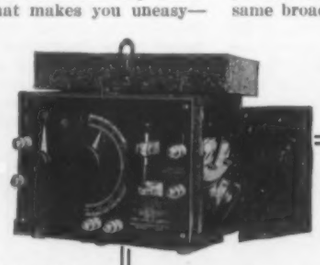
With the Speakers and Artists Who Are Heard But Not Seen Over the Radio-phone

By Austin C. Lescarboura

"DO you prefer to stand when you speak, or do you wish to sit down? You prefer to sit. Fine! Now let us get the scenery together. We will use this little table with the lamp, so that you can read your notes. Now for the transmitter. Is it about right at this height? Yes, that's about right. Don't forget, talk directly into that little hole, good and loud, and keep up your voice throughout the talk. About three inches away from the transmitter is a good distance. All set? Let's go!"

The announcer is speaking to you at the radio-phone broadcasting station. You are a speaker on this evening's program; your name is among the several names featured on the printed program for the week, as well as reproduced in many newspapers throughout the broadcasting area.

If it is your first try at radio-phone broadcasting, you will experience all sorts of queer sensations; for this, in truth, is no ordinary task. The studio in which you are to speak is small and home-like enough, and there are just a few persons present. There is barely room for an excuse to be shy. Yet it is the very weirdness of the whole business that makes you uneasy—the thought of speaking through a little hole in a cylinder hanging in front of you, to an audience that mounts up into the hundreds of thousands.



If you have your speech carefully written, there need be no undue stage fright. After all, it is not so awe-inspiring. The first few words, addressed at the little cylinder dangling from the adjustable stand in front of you, are soon put over, and then you settle down to reading your speech with less and less thought given to the intricacies of radio, and to the other persons in the room and the huge radio audience whom you are addressing. In fact, you soon become so absorbed in your speech and in pronouncing each word clearly and carefully, with a pause at irregular but well-planned intervals, to lend weight and forcefulness to your message, that you are unaware of the hundreds of thousands of listeners.

The end of the speech is soon reached, as it must when you are so absorbed in a given task. The announcer, who all the while was sitting in a corner of the room, notices that your speech has been drawing to a conclusion. He steps over to a cabinet on which a switch is mounted, and as you pronounce your last word, pulls the switch.

And much to your surprise, absolutely nothing happens. Of course, nothing should happen in this case; but somehow or other you are not accustomed to addressing a mute and invisible audience. There is a dead silence. No applause of any kind. No comment.

Perhaps something went wrong. It is hardly believable that the speech got beyond the four walls of the room. Still, the man in charge of the program thanks you and leads you out of the room, as the announcer steps up to the transmitter and states once more that "This is station XYZ. Madam Soprano of the Metropolitan Opera Company will now sing for you. The first song is ———."

The next morning, coming down to the office, two friends inform you that they heard your speech. Several telephone calls come in during the day, informing you of the successful reception of the speech. A number of letters, post cards and even telegrams dribble in for the next few days, depending on the interest created by the speech. For several weeks you are reminded at odd intervals of that speech which you made at XYZ, by friends, relatives, acquaintances and strangers, until you wonder if people ever do much else than listen in to radio-phone broadcasting. But it got across, and that is the main thing!

Broadcasting is a new art. It is little more than a year old, and like any young art it is full of that rare interest which must exist in any art until it has simmered down to an established basis. There are no set rules in broadcasting procedure. Much of the work is still on an experimental plane. Even the broadcasting stations themselves are in a transient stage and resemble nothing more than the usual motion-picture studio, in which everything is done for the gaze of the camera rather than for the comfort and convenience of the performers. Indeed, the more we learn of the gentle art of broadcasting, the more we notice a striking parallel between it and the motion picture. In their general characteristics they are much alike, these two young arts. One deals with pictures, animated pictures which tell stories; the other deals with sounds—speeches, songs, news, weather forecasts, children's bed-time stories, financial reports, business statistics, marine news, time signals, and whatnot.

Having grown up over night to gigantic proportions, the broadcasting art is unwieldy in the extreme—not so much in a technical sense, because the broadcasted talks and music are quite excellent, as anyone with a receiving set will gladly affirm. From a business standpoint, however, the art is truly anomalous. Here are over one-hundred stations providing speeches, news, music and so on for hundreds of thousands of listeners, yet deriving no direct financial returns. Granted, these same broadcasting organizations are for the large part engaged in the manufacture of radio apparatus and are reaping an astounding harvest of business, the fact remains that there are many other radio manufacturers harvesting just as rich a crop without spending a single cent or devoting a single moment to the sowing of that radio crop. It is highly unfair, to be sure.

RADIO today is a continuous performance. You purchase your ticket in the form of a receiving set, such as the little one shown in the accompanying illustration, and then listen in day in and day out, whenever and wherever you please, to the music of today, the classics of yesterday, the leaders of the nation, the scientists, the news of the minute, stock quotations, and so on, without further charge of any kind. For such is the radio broadcasting art of today. But what about the broadcasting end? Who foots the bill? Why? Who are the artists and speakers who volunteer their services? In brief, how long is this going to last? The accompanying article is the result of the various impressions gained in studying the expansive field of radio broadcasting, and in visiting several of the broadcasting stations. Sufficient material has been obtained for several articles. A list of radio-phone broadcasting stations appears on page 428.—THE EDITOR.

Then again, the audience, after purchasing the original receiving set, never contributes a single cent toward the maintenance of the broadcasting stations. Occasionally a vacuum tube must be purchased, as well as a "B" battery, galena crystal, pair of receivers, and so on; but as likely as not this business may go to a concern not engaged in broadcasting.

Such a situation is identical to that which would exist if phonograph companies sold their machines and then supplied the records free of charge for all time. Obviously, such a business is not founded on logic. While the radio boom persists, a few companies can well afford to maintain the radio-phone broadcasting stations; but sooner or later other arrangements will have to be made. Whether a charge will be necessary for broadcasting reception, or whether a charge will be made for the privilege of speaking or singing via radio, the author does not profess to know or even dare to guess. Still, the present situation is constructed on unstable lines and must sooner or later give way to something more substantial.

So we come to the question of talent—the singers and the speakers and others who entertain us night after night. To them we owe much, because so far their services have been offered without charge of any kind. Even so, the leading musicians of the world have sung and played for the radio audience, and many more are scheduled to go before the little cylinder or the "dish pan" before long.

At this stage of the art, the average radio-phone broadcasting station is an improvised affair. How could it be otherwise? It was inaugurated over night to take advantage of the technical advances in radio telephony. Since then, it has never had the necessary time to spare in order to build a real broadcasting studio with every comfort for the talent and with some consideration for the visitors.

A typical radio-phone broadcasting station may be described as follows: A long, narrow room, formerly used as a cloakroom for the office employes, has been appropriated for the broadcasting activities of the company. At one end stands a beautiful piano of the reproducing variety, with its long bench. This piano may be played by a flesh-and-blood pianist, or by Grainger, Godowsky, Rachmaninoff or Hoffman, not in person, of course, but in the form of a perforated paper roll. Then there are several phonographs of various makes, for the broadcasting studio does not play favorites. Along one of the long sides of the room is a small table, with a silk-shaded lamp to add a touch of home atmosphere and to reassure the performers, followed by an automatic organ, several desks, and plenty of chairs. It is just a plain room, with very little embellishment except some draperies which can be placed over the bare walls whenever it is necessary to hide them with all their ugliness. In fact, most of the photographs taken in the radio-phone studio are flashed only after the draperies have been artistically arranged, while a few flowers or plants bought or borrowed from the nearby florist help matters ever so much. The last pieces of furniture—and the most important, perhaps—are the cabinet containing little lamps and plenty of switches, wiring, and so on, comprising what is called the modulating equipment, as well as the little transmitter mounted on a portable stand. The cabinet is a wooden framework covered with copper screening, not for the purpose of keeping out flies or mosquitoes, please be sure to note, but to prevent the delicate apparatus from being disturbed by electrical and magnetic influences within the room itself. For that matter, the various conductors connecting up the cabinet and the transmitter are sheathed in beautiful, bright and neat woven copper sleeves or tubes, not for the artistic but for the electrical reason mentioned.

The radio-phone transmitter proper is located in a small room near the roof of the building, and is attended by one or two operators. This is the actual radio-phone station, for it contains all the elements of transmission. When the studio is to broadcast, it is connected with the radio station upstairs by means of the switch already referred to. A system of wire telephones assures instant communication between the studio and the station.

The radio-telephone transmitter consists of a cabinet closed in by iron grill work, so as to preclude damage to the delicate vacuum tubes. Five tubes are employed for normal operation. The transmitter is at the extreme end of a long operating desk or table, on which are placed ordinary telephone instruments, radio apparatus, a receiving set with amplifiers, telephone headsets, and a loud-speaking device. While the studio is in operation downstairs, the operators hear the speech or music by means of the loud-speaking device, actuated by the long-distance receiving set at the end of the table. The receiving set is connected to a single wire antenna, and serves principally to pick up the Arlington time signals which are amplified and then impressed on the radio telephone transmitter so as to be retrans-

mitted to the radio-phone audience on 360 meters.

The aerial is a large affair, as all aerials for wireless telephony must be for good results. It comprises eight wires supported on wide spreaders and tall steel masts, high above the roof. Below it is another aerial, about eight feet above the roof, known as the counterpoise. This secondary aerial serves as the ground and gives better results for radio-phone transmission.

Always has radio been a temperamental thing, if inanimate things can be temperamental. It has worked best when nobody was around to appreciate the fact, and worse when it has been on parade, so to speak. Today the same holds true. The radio-phone, with its delicate tubes and controls, sometimes lies down on the job at the wrong moment. And on this fact hangs many an interesting tale.

Not so many weeks ago a large band composed of the musical employes of a leading manufacturing company were featured on the evening program. They came to the broadcasting studio and they played—played as they had never played before, fully realizing that they were playing for hundreds of thousands of listeners. The radio-phone devotees, scattered over a wide area, were delighted as they are always delighted when listening to a good number on the radio-phone program.

Then things began to happen. First one tube, then another tube blew out, up in the radio station. These tubes, or vacuum tubes to be more specific, are made up in the company's factory in small lots, and there is seldom a real reserve supply on hand. Finally, all the tubes were blown out, and the station was simply through. The announcer in the studio below was informed of the fact; but, taking account of the enthusiasm of said band which had come from some distance away to entertain the radio audience, he did not have the heart to tell the musicians what had happened. Instead, he simply went right on, announcing the various selections in turn and letting the band play to their heart's content, even though the sounds never got beyond the four walls of the studio.

Then there is the other side of the same picture. The radio-phone devotees were listening to the wonderful band concert when suddenly, without notice, although the band music had been getting weaker, there was a total silence. What could the trouble be? Every radio-phone receiver right then and there was overhauled by as many greatly agitated radio-phone enthusiasts, in search of trouble. And this story explains to many of them what happened on that particular evening, when the radio-phone suddenly went dead.

Please remember that there is a switch in the radio-phone studio that stands between the studio and the outside world. A number of stories could be told about that little switch, although just one story will suffice.

Every so often an artist, a talker, or an orchestra is scheduled to appear before the radio audience, because they are willing to do so in the first place, and they have been passed upon as worthwhile entertainers by the radio-phone management. It is virtually impossible to have tryouts, as can well be appreciated because all the talent is purely voluntary and there are many drawbacks when dealing with anything that is free of charge, as you may well know from practical experience. At any rate, the performers or entertainers are passed upon solely on their past record. If they have played in public, if they hold a diploma from some school of music, if they are well known in their respective fields, if they occupy an important position—all these factors count for their face value in considering the suitability of a speaker or musician aspiring to an "appearance"—an unfortunate word, but there is no word yet coined to meet the circumstance—before the radio audience. As a matter of fact, the various radio-phone broadcasting stations, especially those in the large metropolitan districts, have more applications for space on their programs than they can possibly catch up with for a long time to come.

Anyway, the evidence in the case is not always a good guide. Every so often a small orchestra makes its initial bow before the transmitter of the studio and it does not take much more than the first few bars of music to convince the announcer and the station management that a mistake has been made. Then the little switch comes into play. The announcer maneuvers about until the switch is reached, and then, without formality of any kind, the switch is pulled, disconnecting the studio from the outside world. The orchestra, meantime, plays blissfully on, not aware that its audience is encompassed in the four walls of the studio. Meanwhile the operators in the radio station, realizing what has taken place, take hold of the radio-phone program and bring a phonograph, kept in their room for that very purpose, into action. They continue to operate the phonograph until some happier moment, when the announcer downstairs can introduce the next number on the program.

Numerous cabinet receiving sets are now making their appearance for home use. This one is a combination radio and phonograph entertainment device, which can be operated by anyone

Sometimes a speaker does not confine himself to his subject, but wanders into the publicity field, soon waxing eloquently with praises of ABC automobiles or PDQ shoes or XYZ bread, and so on. He can rest assured, whether he realizes it or not, that rank publicity will not be sanctioned in the usual well-managed broadcasting station. There may be public radio-phone broadcasting stations in the near future, where the publicity hunter can exercise himself to his heart's content; but for the time being he is not allowed to burden the radio-phone audience with his talks while some legitimate entertainers are crowded out.

Temperament—of course there is temperament in the radio-phone studio, just as there is in the motion-picture studio. Often this temperament results in queer incidents. A case in point runs as follows:

Early in the history of radio-phone broadcasting, all stations were required to "stand by" or remain inactive for a period of three minutes, every fifteen minutes, in order to listen for distress signals from ships at sea. A prima donna from some well-known opera company had just rendered an aria from "Aida," if my recollection serves me correctly. The announcer, going about his work in the business-like way that comes through doing the same thing day in and day out, stepped up to the small transmitter, and said: "We will now stand by for three minutes, to hear distress calls." Imagine a high-strung, temperamental, famous prima donna, not previously informed of this very necessary bit of business, listening to this remark at the end of her song! What she said to the announcer cannot be printed here, but suffice it to say that she used up all her choice adjectives, and gasped for more.

Another time a Russian singer worked himself up to a high pitch while singing a very difficult operatic air. The broadcasting studio is a very small room, you will remember from my previous description. At any rate, the singer tore off his coat, followed shortly after by his collar and tie and then his shirt, singing all the while before the dish-basin transmitter then in use. Needless to say, the announcer had to act quickly for there were ladies in the room. He signaled to several of the men present to help him move some draperies in front of the rapidly disrobing Russian singer, who, when he had finished his song, asked what was the idea of wrapping him up in draperies. He had not realized what he was doing, so we are assured by the broadcasting station announcer.

Another time two Italian singers were rendering a duet before the "phonetron," as the "dish-basin" transmitter is called. One singer was the possessor of a good, rich voice. The other's voice was impossible. The man with the good voice could stand it no longer, and he began nudging his partner and swearing at him in Italian. This continued all through the duet, despite the admonitions of the announcer. There was no little switch in those days to cut off the unruly performers from the outside world. In fact, such instances as this caused the switch to be introduced. There followed a flood of inquiries, asking why the monologue accompanied the various selections. It was a new idea, but why? asked the inquisitive radio audience.

Another instance, prior to the installing of the switch, took place when another prima donna came to the studio to render a few selections. This lady decided to accompany herself at the piano. The announcer, having become aware of the profane ways of the lady, decided to take no chances. So, taking the transmitter off the stand, he climbed up on the grand piano and pointed the transmitter toward the lady. All during her various selections she is reported to have cussed pretty much everything about the place, and the announcer busied himself "shorting" the microphone transmitter at such moments as a volley of profanity was directed at him.

Then the performers have their pets, which must come in for some share of the evening's program. One singer brought her Airedale with her. A pampered dog, that Airedale, who could not understand why his mistress was talking and singing into a wash basin dangling from a portable stand. The announcer made several attempts to amuse the dog, fondle it, and in every other way keep it quiet, but to no avail. Between bits of her songs the singer called to her dog, said kind words to him, and kept on talking about Larrie, much to the bewilderment of the radio audience. The next few days several telephone calls and letters were received, inquiring as to who "Larrie" might be. Was it her manager, husband or friend, who was so impatient?

The radio-phone audience watches the radio programs with keen interest. Indeed, one almost begins to wonder if the radio-phone audience is paying for the service, so severe are the criticisms at times. Following an unusual amount of phonographic and automatic piano music, referred to as "canned stuff" by the radio audience, there is certain to be a large volume of complaints. The radio-phone audience is certainly highly critical, just as it is highly appreciative when the program is good.

One thing is certain, and that is the permanency of radio-phone broadcasting. No doubt the present arrangement is not permanent because it is not altogether a fair one. But broadcasting has become so popular and its possibilities are so great that it can never become obsolete, as many would have us believe. Like any new art it has its imperfections, which must be corrected and altered and refined until the art becomes stable, as it must in time.

The radio room of a typical radio-phone broadcasting station. Note the phonograph in the background, the radio telephone transmitter, the loud-speaking device, and the long-distance receiving set, on the table

Our Point of View

Wrecking the United States Navy

THE efficiency of a navy depends upon its ships and its men, and of these the men are by far the more important. The most magnificent assemblage of fighting ships conceivable, if manned by insufficient crews of poor training and low morale, could be readily overcome by a smaller and less up-to-date fleet that was fully manned by officers and men of the highest skill, and of absolutely unshakable morale. The treaty did a noble work in abolishing the threat of naval war, and getting the three leading naval powers to agree to a ratio of 5—5—3, in the total displacement of their fleets. The question of the personnel was left to the decision of these several powers. Great Britain has announced that she is cutting down her personnel to 104,000 officers and men; Japan proposes to reduce her enlisted strength to 68,000; the United States Navy, in the endeavor to meet the demand of the country for extreme economy, has asked, through the Secretary of the Navy, for only 96,000, as the very lowest minimum with which the Navy can be maintained with any approach to efficiency.

In spite of this moderation on the part of the Navy, the House Naval Committee endeavored to cut down the enlisted strength to 67,000 men, and a vigorous and strong fight was made in the House of Representatives to turn this suicidal proposition into law. We do not hesitate to say—first, that the 104,000 men allotted for the British Navy is a reasonable amount, justified by long experience; secondly, that the 96,000 men asked for by our Navy Department represents a smaller force than is necessary to maintain our fleet at all times in a condition of efficiency; thirdly, that to reduce the number to 67,000 would be, in effect, to destroy absolutely the efficiency of the fleet, by causing our ships to be greatly under-manned, and thereby producing a sense of discouragement and neglect in the officers and men.

If the question be asked—Why did our Navy Department ask for only 96,000 men, when the British Admiralty, in manning a fleet of the same size, determined upon 104,000 men, we reply that the 96,000 was arrived at by a board of naval officers, who were asked to determine *the absolute minimum of men that was necessary* to maintain our ships in a condition of fair war-time efficiency—"fair," mark you, not maximum efficiency. In arriving at their estimate they made the following important reductions.

1. The war proved that there must be sufficient men aboard to man both anti-torpedo broadside batteries; the estimate calls for manning only one broadside on one side of the ship. 2. The number of men in the ammunition handling rooms was reduced below that which is necessary for the highest speed of firing. 3. The number of men for bringing the shells from the magazines to the loading trays was reduced to a point which would slow down the speed of delivery. 4. The number of men in the engineers' department was cut down to a point which would make it possible to maintain full speed for no longer than two watches. 5. Target practice rules were modified so as not to require replacement ammunition, thereby cutting down the number of rounds per minute. 6. The amount of target practice throughout the year was reduced, and the speed of the battleships was lowered from twenty to ten knots, and of destroyers from thirty-five to fifteen knots. 7. The "junketing" was reduced to a minimum—that is to say, the use of the ships at National and holiday celebrations was discouraged. 8. Finally, the Board greatly reduced the requisitions for the periodical reconditioning of the ships in harbor.

The strength of 96,000 men, as requested by Secretary Denby, was no mere guess, but was decided upon in an honest endeavor to meet the demand for economy up to a point, beyond which the effectiveness of the Navy would be most seriously imperilled. Hence, we do not hesitate to pronounce the recent attempt to cut our personnel down to 67,000 men as being nothing more or less than a movement, conscious or unconscious as the case may be, to *wreck the Navy*. In a spirit of compromise, the President asked for 86,000 men, and this the House has granted. It is not enough. The Senate should stand out for the 96,000 men, which the seagoing officers of the Navy have found to be the absolute minimum compatible with the efficiency of the fleet.

To Save an Infant Industry

THE war served to develop several new industries in the United States, notable among which were the manufacture of optical glass and instruments of precision and the production of potash for fertilizers. Although the armistice found such industries in good working order, they were not sufficiently established to be able to hold their own against foreign competition, and the Government was asked to protect them to an extent that would prevent their being swamped by foreign importations, and to continue this protection until they were strong enough to stand upon their own feet and meet outside competition successfully. When the question of assisting the optical glass manufacturers was before Congress, we urged that Government help should be granted; and we consider that the arguments which were valid then are equally valid today.

Potash is the most important ingredient of agricultural fertilizers, and normally the United States consumes 250,000 tons of it per year. Before the war this country produced practically no potash salts, and our importation from Germany was 270,720 tons. When the war cut us off from Germany, the Government sent out everywhere an urgent request that everything possible should be done to discover deposits, and push forward the production of potash. Natural deposits were found in the brines of Utah, Nebraska, and California, and costly plants were built to recover potassium from these salts, and also from the dust of cement kilns and blast furnaces, from the waste liquors from distilleries and from beet-sugar factories, from the greensand of New Jersey, and from many other sources. The result was that by 1918 one hundred and twenty-three different plants were producing annually some 54,000 tons of potash. Naturally, in new industries involving the lavish expenditure of capital and operated under costly war conditions, the price of the product was high; but the coming of peace, and the experience which was being gained, both in the laboratory and in the factories themselves, was gradually reducing the price, and gave promise that, ultimately, it would be brought down to a figure which would render possible successful competition with the great German potash trust. The German potash is mined, much after the fashion of coal, from 204 mines, of which 17 are in Alsace and now belong to France. These mines formerly constituted a monopoly backed by the German Government. They have a selling corporation known as the Kalisyndikat. After the war a representative of this corporation made a contract with 34 American fertilizing manufacturers to purchase 75 per cent of their requirements from the German Syndicate, and a fixed tonnage from the French Alsatian Syndicate, at one and the same price.

Now the response of the citizens of the United States to the call of the Government resulted in the erection of over one hundred potash plants, at a cost of over $40,000,000; and the effect of the post-war re-invasion of the United States by the German potash monopoly has been to close down every one of these plants, which at the present stage of their development are absolutely unable to meet the low price, due to the abnormal exchange, at which German potash is being offered in our American market.

In their extremity potash manufacturers are asking Congress to extend a gradually diminishing amount of support to their industry, extending over a period of five years. This protection would consist for the first two years of a duty of 2½ cents per pound; 2 cents per pound for the third year, 1½ cents for the fourth, and 1 cent for the fifth year. The manufacturers are satisfied the improvements which they have made and will continue to make in their processes will enable them at the close of this period to stand upon their own feet. Our present production is about 54,000 tons; but so enormous are the natural deposits in California and elsewhere, that if we can but save the infant industry, its growth will be so large that we shall be in a position not only completely to satisfy our own demand, but to enter successfully the markets of the world.

Highways and Politics

WHEN a great engineering undertaking is being put through under government auspices, the necessity of separating the political and the engineering sides is ordinarily recognized by the most dyed-in-the-wool politician. The engineer may be interfered with, grafted upon, forced to play politics; but the most uninformed ward-boss will understand that after all, an Ashokan Dam, a San Francisco Bay Bridge or a Panama Canal requires continuity of engineering policy and engineering control.

In the small-time engineering work done for local or state governments it is otherwise. An engine can quite well be ordered from a catalog by a Republican, installed by a Socialist, and put into operation by a Democrat elected on a fusion ticket. A street-grading project does not suffer if modified and carried out by another administration. It is unfortunate that the professional man must become the shuttlecock of politicians, but when he engages in this class of work he does so with his eyes open, with full knowledge that politics will determine his tenure.

The engineering of our state highway systems is usually treated as just such a job of routine, which can be batted about from one administration to another without prejudice. In 34 states, whose highway commissions have had an aggregate life of 296 years, there have been, by actual count, 127 changes of executive—an average for each department of one new head every 28 months. Whether the chief officer be State Engineer and Surveyor or Highway Engineer or Superintendent of Roads or Chief of Public Works or Commissioner of Highways, whether he be elected with the rest of the state ticket and hence automatically changed when the administration changes or whether he be appointed by the incoming Governor as a reward for deserving Democracy or rock-ribbed Republicanism, it is the universal American practice to regard his job as an adjunct to the regime in power and a part of the spoils of war.

But the bald fact is that under present conditions highway engineering is just as much in need of a continuity of policy and a long tenure of office as is the construction of a single specific work of magnitude like a big bridge or a dam. Roads must be built that will outlast the bonds that pay for them; that may be kept in good shape at proper cost; that shall serve the adjacent territory and the distant; that shall link up with one another properly; that shall accommodate the traffic of today and be capable of accommodation to that of tomorrow; that shall be safe where they meet, where they cross streams and railroads, where they wind, where they climb. A new commissioner is not chosen for his prior fitness; he must make himself fit after he gets in. He cannot visualize all these needs, or learn how he may plan to meet them, until he has been in office for two years at least. But he is then ripe for eviction in favor of an inexpert successor who must begin all over again.

Our state highway commissions are today a training school for highway engineers—and a source of tribulation to those that are trained. Every policy and every procedure that experience has shown to be good must be sold afresh to each new highway executive; and always the sale is complicated by the fact that the hostile outgoing faction had taken up with the idea, which is therefore probably crooked and certainly an object of deep suspicion.

Our Point of View

With the Federal aid now under way, we shall spend something like $700,000,000 per year on what is intended to be a permanent national system of highways. Federal supervision to some extent goes with Federal aid—but this is not enough. Any private enterprise on which one tenth this sum was to be expended would be started by getting together the most competent engineering staff obtainable, and the members of this staff would know that their jobs were as permanent as their ability to handle them. Would it not be well to carry the same idea of a continuous executive policy into the greatest constructive public undertaking ever launched?

Let's all get together and take our highways out of politics!

Giant Trees in the Olden Days

IF these lines should meet the eye of the owner of an automobile, who happens also, to be a tree lover, we suggest to him that he take a run out to the little village of Basking Ridge, N. J. As he tops the hill he will come rather suddenly upon a fine old church, set in a typical graveyard of revolutionary days, where in rather close contiguity both to the highway and the church, he will see an oak tree of surpassing size and of striking symmetry in its branching and general contour. The villagers will tell him that General Washington, with a section of his army, halted one extremely hot summer day at Basking Ridge, and that he and his staff grouped themselves for lunch around the trunk of the tree, which even in his day was noted for its unusual size. The story may well be true, for this specimen, recently measured by the writer with a steel tape, was found to have a girth of 17 feet 6 inches; and further taping showed that the extreme spread of its branches, out to out, was 120 feet. There were giants on the earth in those days, and there is every reason to believe that this splendid fellow is merely a survivor among many such trees that had grown unmolested, century after century, in the quiet of the primeval forests.

The other day we came across a description of the recent repairs of the great oaken roof of Westminster Hall, London. The roof is a typical medieval structure, and is remarkable for its great span of 70 feet. It was found that some of the timbers were of such great diameter, and maintained their dimensions through so great a length, that the English forests of medieval times must have abounded with trees that were even larger than this solitary survivor among the Jersey hills. Westminster Hall was roofed in 1399. In the intervening centuries the death-watch beetle has excavated hollows in the great timbers in which, says the *Builder*, a "full-grown man could lie completely hidden." Only heart oak was used, and since the hammer posts measure 2' 5" in thickness and 22 feet in length, the trees from which they were cut must have been some five feet thick at the butt and over three feet at 20 feet above the butt. Again, the collar beams, 2 feet in depth, are 40 feet long. The trees from which they were cut must have been 3 feet in diameter 20 feet from the butt and 2 feet diameter 40 feet up. There must have been many such giant oaks. Only in rare cases, as at Basking Ridge, do we see a solitary reminder that the lofty trees of Yosemite formerly found their counterpart in the hardwood forests of Eastern America and the Old World.

The Patent Situation as Viewed by a Federal Judge

RECENTLY in Washington, the American Patent Law Association gave a banquet in honor of Chief Justice Taft and, except for the Chief Justice, the principal address of the evening was delivered by Judge Julius M. Mayer of the United States Circuit Court of Appeals. Judge Mayer has presided over many important patent trials, notably the vacuum-cleaner and the wireless cases, and what he says about patents and patent litigation is of especial interest. We quote portions of his remarks.

"No man can do a particular class of work at his best unless he learns to love that work. Imagination and sentiment beget enthusiasm and enthusiasm helps lighten any labor. Unusual as it may sound, a patent case may often be fascinating. Within the four corners of a record may be a story of a struggle against odds which rivals many a romantic tale. Within that same record may be the history of a minor art or of a great art and the picture of slow steps or sudden leaps in contributions to the world's progress. The inventor in the minor art may have made within its narrow limits a contribution relatively as valuable as the ingenious or far-sighted scientist may have made in a greater art.

"A busy court thus comes in contact with commercial and scientific progress from every angle and from every side. Within the limits of his own court room he learns what is being done in the world, here and abroad, in respect of every activity in which the human mind is engaged.

"If he boards a steamer for an ocean voyage, he carries a patented wardrobe trunk, he finds a patented electric light in his stateroom, he notes for his mental comfort that there is a radio apparatus, which he knows is patented in all or some of its features. As he sits down to his meal, he remembers that his potatoes have been peeled by a patented potato peeler and his lemon meringue prepared by a patented mixing machine. If he prefers a land trip to a sea voyage, he remembers that there is a patented lighting system on the train, that there are patented airbrakes and an infinity of other patented devices for his safety and comfort. If he goes no further than to take a ride on one of the transit lines in his own city, he need but glance at the advertisement above him, to recognize displayed in one color or another, with attractive catchwords, certain familiar friends, from the vacuum-cleaner to the washing machine, the fate of many of whom he has adjudicated.

"It is then a privilege and not a burden to have the opportunity to study and to pass on these steps of human ingenuity which are a part and parcel of modern civilization. In this study the judge is fortunately helped by a well equipped bar. No branch of any profession calls for more thorough study and research, or for a greater faculty for simple and clear exposition. No man can be successful at the patent bar unless he brings to it endless industry and high ability in explaining and clarifying the subject matter of the controversy in such manner that the lay mind, in other words the judge, may grasp the essentials, understand the technique and not be confused or misled by irrelevant or unimportant details. . . . .

"When men are dealing with a branch of law which so intimately touches the safety, the comfort and the happiness of the people, they must be constantly alert for improvements in the administration of the law. The first step, of course, is in the Patent Office and it has often amazed me that so many able and faithful employes, greatly underpaid, have remained in the service. My knowledge of the actual workings of the Patent Office is too barren of practical experience for me to give any practical suggestions. I can only speak in general terms. My feeling has been that the presumption of validity should be stronger than it is; but that presumption can only be made stronger when the equipment of the office is such that the prior art can be completely ransacked and that service in the office may be sufficiently attractive to hold, in this branch of the Government, competent and fully equipped experts. If, when the case comes to court, it appears that there were several references of importance passing from the file wrapper, the presumption of validity amounts to merely a phrase; and thus it is that the courts with reluctance declare void a patent, which may have represented long and expensive effort on the part of the applicant. Beyond the decree which destroys the patent is doubtless many a heart-burning because of money lost and ambition thwarted. In the long run it may well be that the greatest economy will be exercised by the Government in building up and retaining a staff of experts of the highest efficiency. Obviously such a staff cannot be obtained or retained without compensation sufficient, at least, to enable such men to live in modest comfort and make some provision for those dependent on them."

In Justice to Australia

WE have received a letter from far-off Australia, written on the stationery of the Forest Commission of Victoria by an American citizen who is a dry-kiln expert in the United States Forest Service, calling our attention to the extent and importance of the Australian Railway system. Our correspondent was disturbed, and very properly so, to note that in an article published in our December issue, on the railway systems of the world, that of Australia was omitted. He tells us that he went to the trouble of obtaining authentic information from the head of the railway commission in Melbourne, and that he submits it with the hope that we will present it for our readers' attention. We gladly do so—first, because the data is the latest obtainable, covering the year ended June 30, 1921, and also because it enables us to complete our survey of the leading railroads and make good an omission which we greatly regretted at the time it was made, and which was forced upon us by the fact that we were unable to obtain this data at the time the article was written. Our comparison was based upon statistics drawn from several sources, and chiefly from the Bureau of Railway Economics, and the Bureau of Railway News and Statistics, which furnished us with the latest official information received in this country.

Australia, as we all know, is a country of vast distances, and its further development is largely a question of the development of its railway system. Speaking generally, its natural wealth lies in a broad belt of land reaching from the sea coast to varying distances inland. Here lie the gold fields which have yielded such a huge quota to the world's total supplies of this metal, and here also are to be found the grazing lands whose sheep farms have made of Australia one of the great sources of the world's wool supply. Considering the population of Australia, that country has shown an activity in the construction of its railroads which testifies to the energy and far-sightedness of its citizens. Doubtless it will be a surprise to many of our readers to learn from our correspondent that a single suburban railway station in Melbourne, Victoria, handles as many passengers as any other single station of the world and that he has reason to believe that at the present time there are 1500 trains, and, at least 200,000 passengers that arrive or depart each working day of the year. A general survey of the various systems, as furnished by the Australian Government, shows that in all Australia the total number of railroad employes is 109,768; that there are 6044 passenger cars which carried last year a total of 313,579,440 passengers, and that the number of freight cars is 76,322. The total capital invested is £244,625,456 and the total amount of track is 23,263 miles.

Our correspondent writes that, in his opinion, Australia is too little known to America, and that being a United States citizen, and sojourning for a while in Australia, he wished to see that country accorded fair play in our own magazines and scientific journals. We are inclined to think that the degree of knowledge of Australia, possessed in the United States, is greater than our correspondent supposes. Regarding American interest in that great country, it is sufficient to say that the great record which its citizen soldiers made for themselves on the fields of France, has left a permanent impression of the sterling qualities of the Australian people.

Railway Motor Car of Special Design

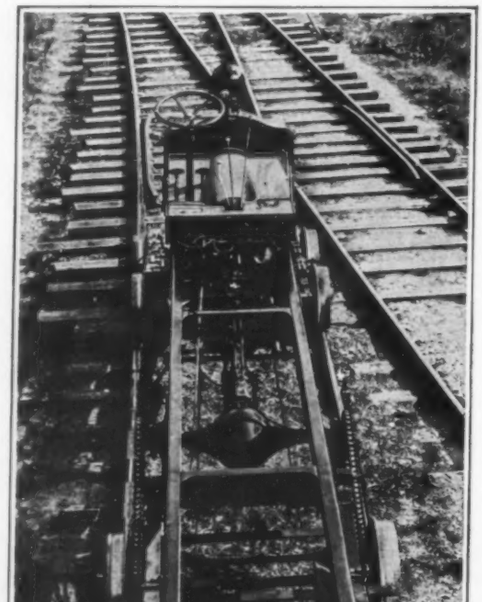
FREQUENTLY we have illustrated in these pages gas-driven railway cars designed for branch lines whose traffic was too light for profitable operation by steam locomotives. These have met with more or less success. Of late years much attention has been directed to the problem of using the regular automobile truck for railway service, and we present with this article a photograph of a railway motor car, designed by H. P. Edwards, which was developed in South Carolina, and has been giving very satisfactory results, particularly in regard to reliability and economy in service.

New type of motor car for use on steam railroads. The total cost of operation for 43,800 miles was 8.18 cents per car mile

Special interest attaches to this car, due to the fact that it was developed by steam railroad men, and the novelties, as compared with other rail motor trucks, are due to certain requirements, well known to practical railway operators, which, it was realized, must be met, if the equipment of the highway motor car was to be satisfactorily applied on steam railroad lines. That they have succeeded is shown by the fact that one of these cars, placed in service on the Atlantic and Western Railroad, ran 120,000 miles for an entire labor and material cost of $1,603.40, at an average maintenance cost of 1.34 cents per mile.

Early in the investigation it was found that you cannot get good results if you merely put a railroad car body, and a set of flanged wheels, on a motor truck—for that does not make a serviceable steam railway car. Standard construction that is well adapted for the highway, was found not to be adapted for railway service. We are informed by the builders that one unlooked for result was that the standard motor car construction will not stand up to the service requirements. It was found, for instance, that a single pair of rear wheels do not provide sufficient traction, for in a snowstorm, or with ice on the rails, the converted truck proved to be helpless.

The car as developed in the railway shops, and shown in our illustration, is carried on two four-wheeled trucks; of which the front truck underneath the engine is of the swiveling type. The rear truck is fixed, and both pairs of wheels are available for traction. The car is driven by a four-cylinder engine, with cylinders 4½ inches in diameter by 6½ inches stroke, capable of developing 50 horsepower. Its weight is 12,000 pounds. The car has a seating capacity of 50 passengers, and a baggage space of 70 square feet. The engine propeller shaft and the transmission are of the standard motor truck type, and the differential and drive shaft are located in front of the rear truck, with chain and sprocket drive to the front axle of the truck, and a third chain, which is inclosed, for driving the rear axle of the truck. The clutches are arranged to give four speeds forward and reverse. The car can be geared for speeds up to 45 miles an hour, and on excessive grades, such as those of 4 per cent, as high as 30 miles an hour.



Chassis of the railroad gas-driven car illustrated above, showing arrangement of engine, transmission and chain drive

The figures showing the comparative economy of steam and motor service, under the same conditions, are of great interest. The car took the place of a regular railway service, which consisted of two round trips daily over a 25-mile run, at a total cost of operation for 12 months of $15,405.90, or 43.08 cents per train mile. In this cost estimate were included train crew wages, fuel, locomotive and car maintenance, oil, waste, etc., and depreciation of engine and car was estimated at 4 cents per mile.

The motor car costs, under the same conditions for one year, were $3,580.48; the total distance run was 43,800 miles, and the cost per car mile worked out, 8.18 cents, including wages, fuel, oil, maintenance, and an estimated depreciation of 2¼ cents per mile. This estimated depreciation was based on the above-mentioned fact that one of the cars ran 120,000 miles at an average maintenance cost of 1.34 cents per mile, and that since the car was in such condition that it was estimated to have an additional life of 180,000 miles, the depreciation charge was put down at 2¼ cents per mile.

This service was instituted to meet the competition of bus lines and jitneys. As soon as a frequent and dependable rail service by motor car was introduced, the above-mentioned competition ceased to be of importance, and passenger revenue showed a proportionate increase.

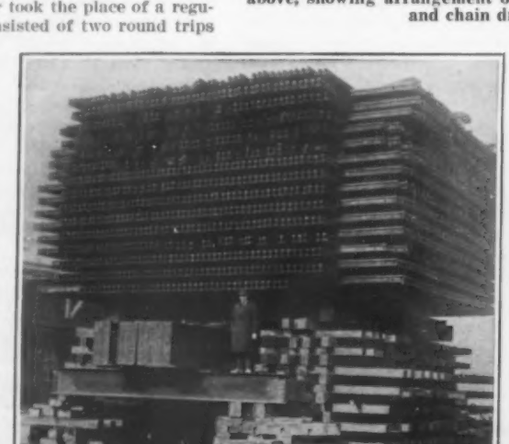
Unusual Foundation Test at Chicago

THE question of the cost of erecting tall buildings is influenced to no little degree by the character of the ground upon which they are built. If the geological formation is such that good rock is found near the surface, the cost of the foundations is very materially lower than it is in locations where the solid rock, or hardpan, is overlaid by material of a loose and yielding character. The worst case is that in which the overlaying strata of poor bearing quality is so deep that the foundations have to be laid upon undesirable material and special precautions have to be taken that the footings of the columns are of sufficient area, and the material upon which they are laid is so securely held in place, that no movement of its mass can take place.

Chicago is unfortunately placed for foundation work, and before the problem had been thoroughly understood and mastered some important buildings had been put up, which subsequently, due to foundation settlement, were badly cracked and called for heavy expenditures to prevent any further extension of the damage. As a result of such experience, future footings were enlarged by the use of deep and broad foundations of steel I-beams embedded in concrete, the mass being stepped out from the footing of the steel column until a sufficient area was provided to give a safe and stable foundation.

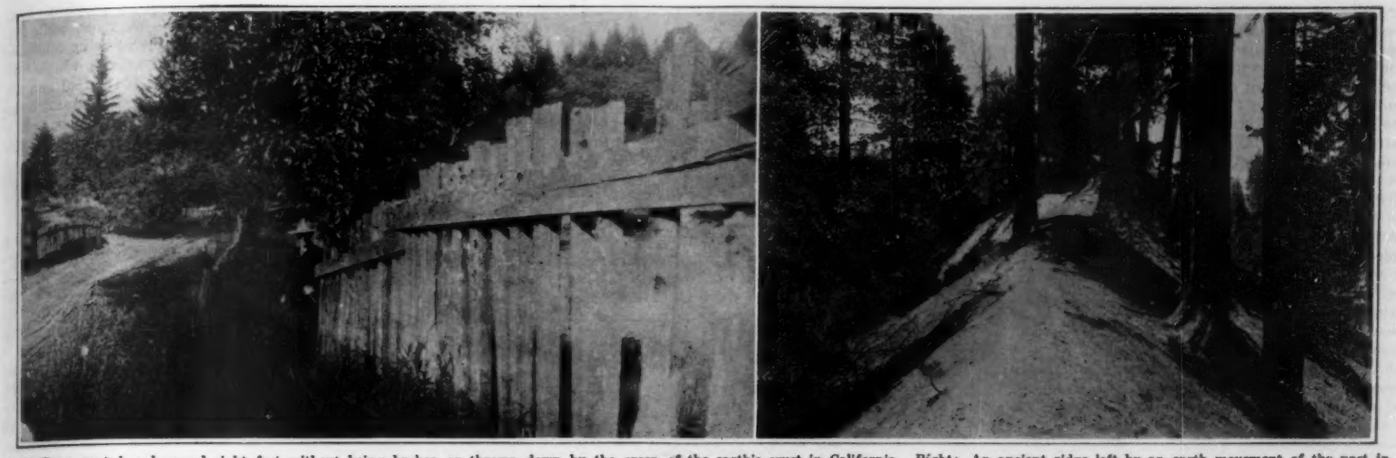
One of the largest and most important buildings in Chicago will be the new Union Station, the engineers of which have made some exhaustive experiments on a large scale to determine the maximum safe load per square foot that can be imposed on the underlying hardpan at the site, which is found at a depth of a little over 70 feet below the surface. By the city ordinance the maximum allowable load on hardpan is six tons per square foot. The engineers and architects of the Union Station believe that this load can be doubled with perfect safety on the foundation piers of their new structure.

It was to settle this question that the important tests which are herewith illustrated were carried out. The engineers decided to impose on the test pier three times the allowable load which the city permits to be imposed upon foundations. To do this they built up a great pile of the heaviest steel rails, weighing 130 pounds to the yard. The total weight of this mass was between 90 and 100 tons. The rails were laid upon a grillage of heavy timbers, one on each side of a test pier, which had been carried 70 feet down to hardpan. For the purpose of putting the desired load upon the pier, a large hydraulic jack of 1000 tons lifting capacity was built and placed between the top of the pier and the load of rails above. One of our illustrations gives a close-up view of this jack. Its height over all is three feet one inch, and the diameter of the steel lifting ram is 21 inches. To get the desired effect it was necessary to raise the pressure of the hydraulic oil with which the cylinder was filled to the high figure of 6000 pounds per square inch. This is done by means of a hydraulic pump, from which the oil is led to the base of the cylinder by means of a thick half-inch pipe. The enormous pressure is delivered from the base of the cylinder to a heavy steel casting resting on the top of the pier.



This pile of rails was used as an abutment for the 1000-ton hydraulic jack shown on the right. The jack rests on top of a test pier, which extends 70 feet down to hardpan. By these means the engineers of the new Union Station proved that a load of 12 tons per foot may be used with safety

The result of these investigations has shown conclusively that where the Union Station is located a load of 12 tons to the square foot can be employed, leaving an ample margin of safety.



Left: Fence parted and moved eight feet without being broken or thrown down by the creep of the earth's crust in California. *Right:* An ancient ridge left by an earth movement of the past in the Mojave Desert region

Some of the works of the earthquakes by means of which it is proposed to learn their schedule

Forecasting Earthquakes

How It Is Hoped to Make the Destructive Quake as Amenable to Prediction as the Daily Weather

By H. D. Benton

ANNOUNCEMENT that it soon will be possible to forecast earthquakes with the same regularity and accuracy as storms, is made from the University of California, at Berkeley, where the discovery was made by Dr. Andrew C. Lawson, professor of geology, co-operating with astronomers and meteorologists in various parts of the world.

It is hoped that when the system of forecasting seismic disturbances has been put on an accurate basis, it will result in the saving of many lives by the foretelling of the more serious or "heaviest" quakes, and in the preservation of movable property, as well as prevention of ensuing fires.

The discovery, which consists in making the earthquake itself warn the world of its coming, follows two or three other discoveries regarding earth movements, and is based on the results of long and close study of the vagaries of strain creep on the crust of the world. The most important of these basic discoveries is that the movements of the earth's surface technically known as "creep of the earth's crust," are antecedents to as well as consequences of earthquakes. That is, the crust of the globe on which we live, to a depth varying from a few feet to scores of miles, is constantly on the move, in a generally northward direction, though, during and immediately following earthquakes, such a movement may be in two or more directions, usually in a different direction on each side of the rift or fault, where the earth's crust breaks under the strain, causing the earthquake.

The "creep" of the earth's crust, to explain it briefly and in non-technical language, is due indirectly to the fact that the poles of the earth do not run true. That is to say, the North Pole, for example, describes a circle of about 60 feet every time the earth revolves on its axis. It is as if the earth were a globe revolving on a shaft which was not true in its bearings. While this deviation of the 60-foot circle is so small, in view of the size of the earth, as to be almost infinitesimal, it is sufficient to set the soil and the rocks, even the mountains and the valleys, in a slow but steady motion, usually to the northward.

Like a liquid tide setting ever in one direction, this current of earth creates a tremendous strain in its own mass. This pull is so great that a distinctly measurable tension ensues in all the layer of earth-crust which is "creeping." When this tension reaches a certain point, something has to give way. The result is a tearing open of the earth's crust, and a backward or a sideways motion—which Dr. Lawson calls "the elastic rebound"—and the visible, tangible phenomenon known as an earthquake occurs. As soon as Dr. Lawson had definitely established the "creep" of the earth's surface, and its rebound under the strain of its own tremendous weight, the mind of the trained investigator asserted itself, and he said:

"If we find the rate of creep and the length of time of creep necessary to produce the limit of tension in the earth's crust, we shall know when and where there is to be the next earthquake, merely by watching closely the increase in tension."

It is necessary, however, that constant, consistent, accurate observations of the rate of the "creep" of the earth's crust be made at frequent intervals. With the known factors of the time and rate of creep necessary to create the limit of tension in the earth's crust, the observer, whether he be in the heart of Africa, on the summit of Mt. Hamilton, or below sea level in the Valley of the Dead Sea, knows all the time whether or not there is to be an earthquake in his section of the world, and, by the rate of creep, within a few hours of the time the "elastic rebound" will take place. "This gives to the forecasting of earthquakes," says the University of California, in its bulletin announcing Dr. Lawson's double discovery, "the same precision as that with which weather forecasts are made."

During past seismic disturbances entire mountains have been moved as much as five or six feet; other areas have been moved even further, buildings, fences, monuments, trees and similar ordinary fixed objects having been carried ten or twelve feet, without being damaged, by a movement of the entire crust of the earth for a considerable distance around the object moved. The segment of the earth's crust which moved prior to the Pacific Coast earthquake of April, 1906, is estimated to have been approximately 15,000 square miles in area, and about 65 miles in depth—that is to say, 975,000 cubic miles of earth shifted distances varying from one foot to ten or twelve feet, depending on its distance from the main center of disturbance, the so-called "San Andreas Fault," running roughly, southeast to northwest, and disappearing in the Pacific Ocean.

With these conditions, it is obvious that the only manner in which the position of any point on the earth's surface can be fixed is by accurate astronomical observation at regular intervals. Even by this method a certain amount of error creeps in, but much of this error will be eliminated by the use of the Ross photographic latitude telescope, which surpasses the international latitude instrument (visual) in accuracy as regards accidental errors. It records on the photographic plate, automatically, and so removes the human element in recording its own observations. The Ross instrument has the further immense advantage of eliminating essentially the whole of the troublesome systematic errors to which visual instruments have been and still are liable.

Some of the figures obtained by Dr. Lawson in his investigations of the "creep" of the earth's crust are of surprising interest, as denoting the movements which supposedly "immovable" mountains and hills have made prior to, during and after earthquakes. From 1854 to 1906, for example, Mt. Tamalpais, a peak rather more than 2000 feet in height, on the Marin Peninsula, north of the Golden Gate entrance to San Francisco Bay, moved 3.04 meters, in a north-northwesterly direction through the action of strain creep. In 1906 it moved 1.97 meters back, by elastic rebound, in a south-southeasterly direction, not along the line of the previous movement.

Chaparral, Cal., moved 2.61 meters, almost due north, by strain creep, from 1856 to 1906, and in a few seconds in 1906, moved backward, in a southeasterly direction, 2.06 meters, almost as much as it had moved in 50 years, by elastic rebound. Farallon Lighthouse, located on an island off the Golden Gate, moved 2.06 meters, in a northwesterly direction, by strain creep, in the 46 years between 1860 and 1906, and in the short duration of the earthquake of 1906, moved

A good example of earth flow. The soft earth formerly filling the cavity in the center of the view could not sustain the tension of the "strain creep" and flowed like a river into the valley below

by rebound, 1.29 meters, almost due west. Other places and groups of places moved similarly, but in varying directions. Yet out of all these movements, closely recorded, studied, compared and tabulated, order can be worked, and the rate of creep, as well as of rebound ascertained. Differences of soil characteristics, and of subsoil structure, have to be taken into consideration, since some forms of soil and rock will endure more strain than others before the tension reaches the breaking point. Another interesting feature of these studies is that no general change of elevation of any of the points has been found of sufficient magnitude to be detected with certainty.

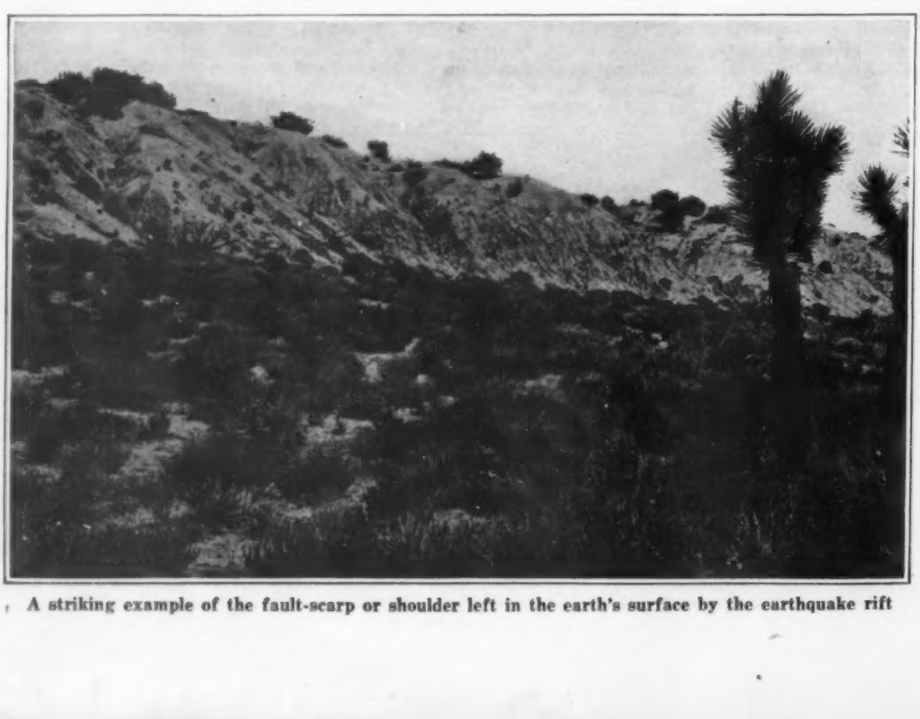
Lake, without an outlet, formed in the California hills by subsidence of land near an earthquake fault. The water is not from rain, but was forced up from below by the pressure that created the bowl

The practical study of the possible movements of the crust of the earth, due to strain creep, is now going on by means of monuments established at Olema, Marin county and Crystal Springs Lake, San Mateo county, California. These points are about 40 miles apart on the rift. Each set of "points" consists of four concrete piers, two on each side of the fault trace of the 1906 seismic disturbance. These piers are sunk about six feet, and founded on the rock "backbone" of the country. The piers rise two or three feet above the surface, those at Olema being 13 inches square, and those at Crystal Springs 18 inches square. A bronze plate is set firmly on the top of each pier, with appliances for holding the instruments always in identically the same position with respect to the pier itself. The instrument consists of a Fauth 10-inch altazimuth, spindles and sockets for accurate observations, the whole locked in a cap fastened to the pier, the keys for which are in the possession of the department of geology of the University of California, which is conducting the observations.

From the observations so far recorded, in addition to the data already described, it has been learned that the speed of the earth waves generated at the fault during an earthquake is from two to three kilometers per second. Two kilometers is approximately one and one-quarter miles, and three kilometers about one and seven-eighths miles. These earth waves pass through the earth's crust too rapidly to be observed, though they may, and frequently do, hurl to the ground persons and animals. These extremely fast waves, however, generate other and slower waves, which are visible to the eye, and thus are recorded frequently by observers of earthquake phenomena who are not equipped with instruments for their detection.

It also has been ascertained that the length, width or depth of fissures in the earth's surface, caused by earthquakes, are not true indicators of the intensity of the seismic disturbance, since different formations of the earth's crust react differently to the forces applied by earthquakes. The old and well-beloved story of the stopping of clocks also is an uncertain indicator, either of the time, or the duration, or the intensity of the shock. From hundreds of reports it has been well established that the first indication of an earthquake apprehended by man is the putting into motion of a liquid at rest. This usually is noticed before the physiological sensing of the actual quake by man.

Now, however, through the work of the observers at the international lati-stations all around the world; of the men of the United States Coast and Geodetic Survey, and of the members of the geological and astronomical departments of the University of California, the world will know without waiting for these physical phenomena, just when and where the earth will wrinkle its face to such an extent that it has to yawn—in the shape of an earthquake.



A striking example of the fault-scarp or shoulder left in the earth's surface by the earthquake rift

Testing Scales

TECHNOLOGIC Paper of the Bureau of Standards, No. 199, "Method for Precision Test of Large Capacity Scales," outlines a scientific and systematic method used by the Bureau of Standards for testing railroad master and grain hopper scales. A pointer and scale are arranged for reading the position of the beam; and the errors of the scale are determined from observations made upon the freely swinging beam. The procedure of the test is explained with the aid of a record form and computation sheet which was developed in connection with the successful application of the method in the field. In the interest of a uniform and efficient method the scheme outlined is recommended for adoption by those who have occasion to carry out tests on large scales where accuracy of a high order is required. This publication is now ready for distribution, and anyone interested may obtain a copy by addressing a request to this Bureau until the free stock is exhausted.

Fast Cotton Dyeing

DUE to the discoveries of Mr. John Macadam, a Scotch chemist who has been in America for nearly 30 years, scientists and dye experts believe the age-old search for actually fast colors as applied to cotton goods is at an end.

It is generally known that wool has the greatest attraction for coloring matter and is, therefore, more readily permanently dyed. Silk is intermediate and cotton has the least affinity for dyestuffs and is, therefore, the most difficult to dye with fast colors. Moreover, cotton behaves differently in dyeing toward various coloring matters. It attracts some dyes, while it is incapable of being colored by other dyestuffs which readily color both wool and silk. One method of dyeing cotton goods is by steeping them in a hot solution of the coloring matter, which is done by using what is known as the simple, direct, aniline dyes.

Other dyes, such as those known as the basic colors, for which cotton has practically little or no attraction, must be deposited in the form of a lake after the goods have first been impregnated or prepared with a metallic salt or some other agent. This agent is capable of combining with the coloring matter and precipitating in it the colored compound more or less upon the surface of the fibers.

However, to obtain actually fast colors, a still more complicated physical and chemical process must be used, whereby the special coloring material is impregnated uniformly throughout the fibers of the cloth and then developed and fastened by a method of "reduction or deoxidizing." This process is so difficult to control in the dyeing of piece goods that even though the best dyers of Europe and America have given years to experimenting to discover a practical method of application, it has only been comparatively recently that this thing has been actually accomplished in a commercial way in England. However, the English method was not suitable for the large production and type of fabrics needed in the United States, and after many months of expensive research experimentation, an American concern improved the English process and put it on a practical basis to meet domestic requirements.

Cotton suitings colored by this process are linen-finished, all-cotton materials, somewhat like bonch cloths, but piece-dyed by a new process, which for the first time assures a permanent color. This process does not injure or adulterate the cloth, and the body of the cloth as well as the colors remain the same after repeated washings. The dyes used are from the anthracene group of vat colors and include such shades as pongee, heliotrope, brown and various shades of tan, as well as blue, green, yellow, gold, corn, light and dark pink and lavender. These colors are actually fast to all modern uses.

They have been exposed for 168 hours and more to direct sunlight under glass, which intensified the sun's rays so that ordinary fabrics would bleach gray in 48 hours. The samples were covered with iron plates, cut with holes and screwed down over the cloth, allowing the sun to shine through on the fabric. At the end of the test there was no perceptible difference in color between the protected and exposed parts of the samples.

These same goods were thrown into a boiling solution of soapy water far stronger than any used in home or laundry, and finally submitted to treatment with acids. The colors were only affected by such chemicals as destroyed or damaged the cloth itself.

These suitings have been exposed to sun, wind, rain and salt air for weeks, on one of the bleakest spots on the Atlantic seaboard, without any appreciable fading. Lye soap and numerous proprietary washing and bleaching agents do not affect the dye. Perspiration and uric acid are equally harmless. In fact, so confident are the makers that these dyes are absolutely fast that they are wholesaling to tailors under a guarantee which covers not merely the value of the fabric, but also the cost of making it up into the finished garment.

Utilizing All But the Squeal

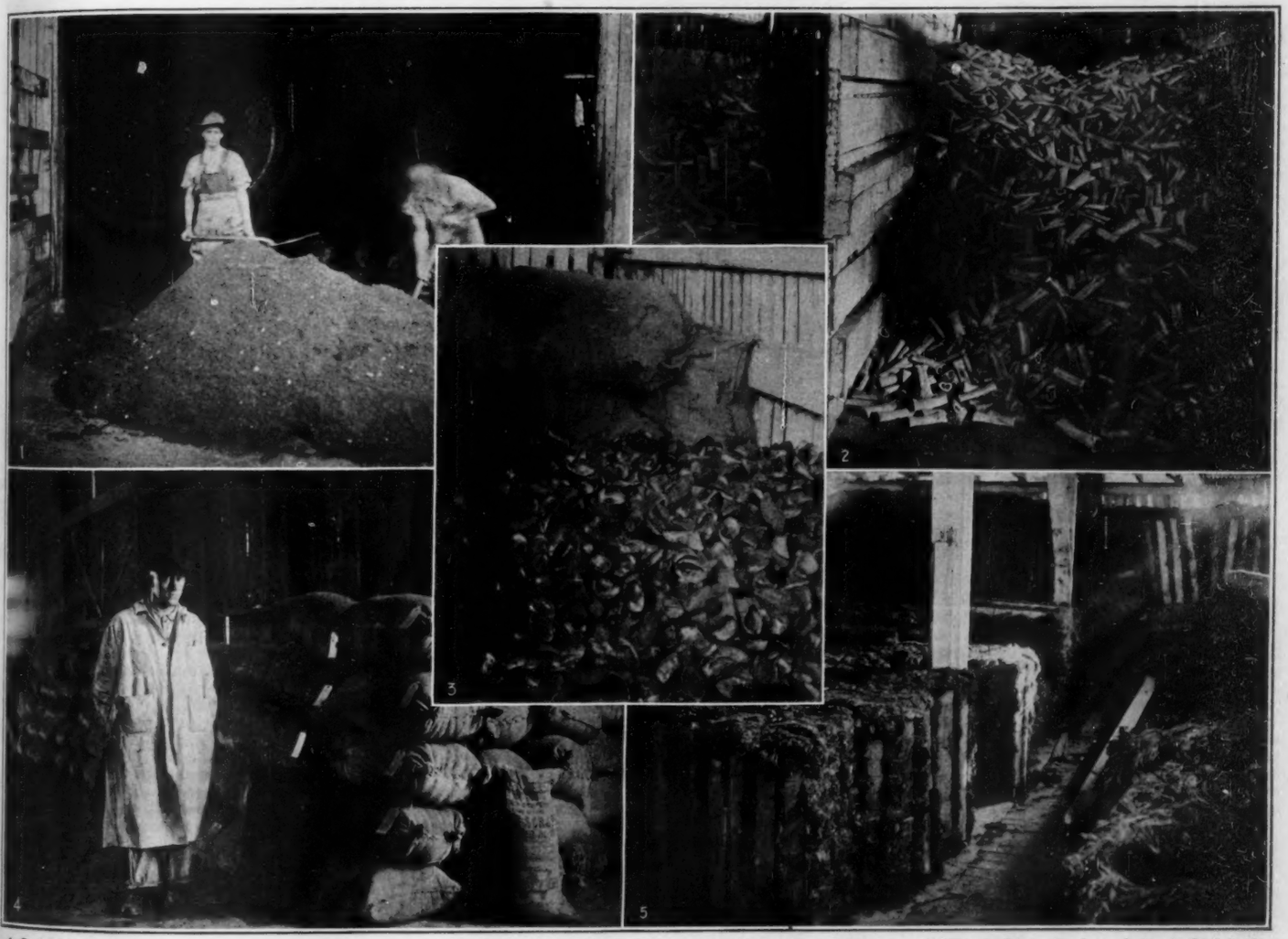
A Survey of the By-Products Produced by Our Leading Meat-Packing Plants

By Charles Alma Byers

BY-PRODUCT development has doubtless received more attention and been brought nearer the ultimate maximum in the meat-packing industry than in any other line of business. Waste, in the word's literal or actual meaning, is, at all meat-packing plants which are in any sense progressively conducted, an absolute misnomer; yet from such concerns undoubtedly comes a greater output of so-called waste-products, in value, quantity and variety, than from any other one field of industrial enterprise. This has been apparent for many years, with perhaps the result that the idea had come to prevail, with the public, that materially further progress in the direction was not to be expected. Nevertheless, new discoveries and new markets in further in nearly 250 finished forms, employed somehow in medical practice.

Glands and glandular material quite naturally constitute the branch which possesses the broadest and most varied possibilities, both in the matter of sources open to selection and in respect to their uses. In fact, practically every known gland in the animal body—lymphatic, thymus, thyroid, spleen, pancreas, and so on—is selected and, after proper preparation, somehow employed in the modern treatment of human ills. And usually the kind or kinds of glands or glandular material selected and prescribed and the nature of the illness or physical trouble for which it is to be prescribed and used are of more or less like character or

It is not to be inferred, of course, that these derivatives for medical use are obtained from all or any considerable proportion of the animals killed at the packing plants, nor are they selected promiscuously. Instead, they come only from very carefully chosen specimens, and the treatment of them following selection is, of necessity, a matter requiring the utmost study and skill of trained experts. Some of them are obtained from the beef animal, some from hogs, and others from sheep and, occasionally, other animals. In fact, as is thus seen, from out of recent advances or developments in medical science has risen about the packing industry a side-line business that is not only of unique interest but of unusual importance in the mone-



1: Desiccated blood and tankage being mixed for use as fertilizer, with two desiccators in the background. 2: Bins of carefully cleaned and assorted bones, used in various by-products. 3: Cattle hoofs waiting to go into the glue-pot. 4: Fertilizer and hog-food in 100-pound sacks, ready for market. 5: Baled hog-hair which, after proper treatment, will probably find its way into automobile cushions.

Some of the scenes that mark the effort to use the products of the slaughter-house to the last penny's worth

tary sense, with the result that medical laboratories have come to be regarded as a quite legitimate adjunct of the meat-packing plant.

The by-products originating from the slaughter of animals primarily for food purposes, to revert to the subject in its comprehensive sense, are perhaps almost innumerable. This becomes especially true when it is recognized that different packing companies avail themselves of somewhat different ways of disposing of or utilizing their so-called waste. The field ranges all the way from leather for shoes and a multiplicity of other purposes to a very popularly used ingredient of ice-cream and certain kinds of candy, with glue, household cleansers, hair for mattresses and automobile cushions, fertilizer, stock foods and various other out-

therance of the development of by-products from such source are constantly materializing.

It is perhaps in respect to the use of animal derivatives in medical science that the most interesting development as to by-products in the meat-packing industry has taken place in recent years. The use of animal glands in therapeutics is by no means limited to surgery, nor is it restricted to the use of monkey glands or even to the utilization in the raw state of glands of whatever kind. In truth, gland usage is immeasurably more common among physicians than among surgeons, and it is, moreover, almost exclusively from the domestic meat animals that their supplies are derived. From animals slaughtered for food some two dozen different animal parts and substances are recovered and,

source. Desiccated blood, or red blood cells, constitutes another much-used animal derivative in medicine, being, because of its percentage of hemoglobin, regarded as especially beneficial in cases of anemia or similar disorders traceable to impoverished blood. Various derivatives also come from the brain and spinal cord, the liver, the gall bladder, and any number of other parts or organs of the meat animal. Then, too, there is, of course, pepsin, which is a proteolythic extract from the glandular membrane of the stomach of hogs. Likewise in this connection it is appropriate to mention benzoated lard, which comprises a very great output. It is quite the same as ordinary lard, or rendered hog fat, to which, however, is added about 1 per cent of benzoin. It is very largely used as a base for ointments.

puts scattered somewhere between or about these extremes. It has been said, and probably truthfully, that, by giving a little special attention to the matter in a specific case, the by-products possible of production from a given animal can be made to exceed considerably in retail value that animal's whole yield of meat. That, naturally, is merely illustrative of a possibility, and not a feasible plan for actual adoption.

It is leather from hides, of course, which constitutes the one by-product of the industry with which we are most familiar, because it is the oldest and doubtless the most generally used. To undertake even to enumerate the uses to which the leather made from the hides of meat animals is put would be an almost endless task. From the hides of such animals, however, come several things besides leather—hair, gelatine, and, indirectly, lanolin, for instance.

As to hair, the industry's principal output comes, of course, from hogs. Every large meat-packing plant has a by-product of hog hair bulking into hundreds or thousands of tons annually. Temporary disposal of it consists in its being dried and put into bales, of about 300 pounds each. Eventually, however, it is thoroughly cleaned, and then "roped," the latter treatment being for the purpose of giving it curl. It is then disposed of for use in stuffing automobile cushions and for other similar purposes. The hair from beef animals naturally reaches the market mainly by way of the tanneries, and is in demand for various kinds of padding, stuffing for cheap cushions, for plaster bonding, and so forth. The tail switches of such animals, however, comprise a direct and quite important output of the packing plants. They accumulate to the amount of tons and are disposed of for the manufacture of high-grade curled-hair mattresses. Wool is the hair product of sheep, of course, but it can hardly be regarded as having connection with meat packing, for the animals are ordinarily, if not always, sheared before being slaughtered. From this wool, both that which is sheared and that which remains on the skin, is obtained the valuable fatty mixture called lanolin, used in pharmacy as a base for unguents—face creams and such preparations.

Gelatine is a particularly important and valuable by-product of meat-packing plants. It is obtained not only from beef hides, but also from the bones and a number of other minor parts of the animal. It is in extensive demand, as is generally known, for the manufacture of many brands of jelly powders and other gelatine preparations used in the making of desserts and other edibles; but, as constituting a fact perhaps not so well known by the general public, it is also very extensively used in making ice-cream and marshmallows, for binding and stabilizing purposes, and by bakers and biscuit-makers for icings. Large candy factories and ice-cream makers, in fact, frequently order gelatine from the packing houses in hundred-barrel lots.

Because gelatine comes from hides and bones is, however, no legitimate reason for one to develop any squeamishness over eating it. In its manufacture it is purified and rendered absolutely clean. The first step is to thoroughly cleanse the bones and hides by the application of hot water and steam. This is followed by the process of crushing and boiling out the gelatine, which is held in small cells. The product, at this stage, is in liquid form. It is next distributed to a broad running belt and there maintained at a temperature of about 40 degrees Fahrenheit. It is thus congealed and brought to sheet form, after which it is thoroughly dried and crushed, to reduce it to the granular state—when, being in a form somewhat like sugar, but of a light buff color, it is ready for the market. About six different grades are made; the stronger the jelly surface which it will yield, the better the grade and the higher the price.

The bones which naturally accumulate about meat-packing plants in very large quantities also have by-product value in a number of different ways aside from their utilization in making gelatine. Hence, they are always saved; and, moreover, quite regardless of the purpose for which they are to be used, they are invariably thoroughly cleansed and carefully graded. They are extensively used in fertilizers and in stock and fowl foods, in each case to add phosphate value. The manufacture of these two by-products comprises a very important side-line business of the meat industry, nearly all large packing plants maintaining special departments to carry on this work.

Other waste than bones enters, of course, into the manufacture both of fertilizers and of stock foods. These consist of what is broadly termed "tankage"—miscellaneous scraps, refuse from entrails, blood, and so forth. Blood, which naturally is a very considerable waste output of the packing plant, is a particularly prominent ingredient of these by-products. First, it is drained to a large tank or vat, and there, when the tank is fairly well filled, quite thoroughly cooked, by means of steam pipes; next, it goes into great desiccators, where it is dried by a method of steam heating, and, finally, it is ground and screened—whereupon it is reduced to the form of very fine powder, of a dark red color.

The meat scraps and entrail refuse are handled in very much the same manner. The bones which are to be used in these by-products are also ground to meal-powder condition. Different feeds, as well as the fertilizers, naturally contain different proportions of the elements, and the mixing of the ingredients, which is usually done just before marketing and to meet specific requirements, is therefore done on a basis of scientific analysis. The desiccated blood, however, often finds a market without admixtures, either for use in its pure state or for use by outside fertilizer manufacturers.

It is a true saying that nothing goes to waste about an up-to-date packing plant. Here, therefore, must be mentioned another form of fertilizer product—namely, what is called "stick." It consists of a liquid or semi-liquid waste, produced in the washing and cleansing not only of the meat and other animal parts, but of the floors and rooms generally. This "stick" is rich in ammonia, of which it ordinarily contains about 11 per cent, and in other refuse elements useful in manufacturing fertilizers.

Hoofs and horns also bulk to a great quantity around the meat-packing plant. They are used, as perhaps nearly everyone knows, in the manufacture of glue, doubtless producing hundreds of barrels yearly. Not even the teeth of the slaughtered animals represent literal waste. They—like bones to some extent also—are used in manufacturing certain kinds of household cleansers, and in other ways common to the usage of bones.

The intestines of the various animals are also responsible for at least two by-products of considerable importance. The most of them, of course, are thoroughly cleaned and used for casings—for sausage and similar ground or chopped food. From sheep intestines, however, comes practically all the catgut used in surgery. The demands made upon surgery catgut are naturally very exacting, and the manufacturing process, besides necessitating care and skill, is a somewhat complicated and tedious one.

Every Lamp Socket a Radio-Phone

General Squier's Latest Application of Wired Wireless and What It Means in Radio-Phone Broadcasting

By S. R. Winters

EVERY electric lamp in the millions of American homes is a potential radio-receiving station. Displace one of the bulbs (or probably one of the sockets is already unoccupied) and insert the receiving plug at the end of the extension cord in the same fashion as an electric sweeper, flatiron, or other electrical appliance of the household. Forthwith, music or vocal speech is garnered out of space. Thus every city, with electric transmission lines, may negotiate its own broadcasting service and escape the babble of confusion imminent from the amazing growth of the distribution of music, lectures, and conversations broadcast through space.

The use of the common office or home electric lamp as a source of supplying the mysterious wave energy for the reception of radio-telephone communications is a fresh application of "wired wireless" or "line radio," a discovery of Major General George O. Squier a dozen years ago. The applications of this principle of radio-telephony and radio-telegraphy, whereby high-frequency currents are guided along established telephone or telegraph wires instead of circulating unaided through ether, unfold with surprising swiftness. Hardly is the bulletin board of the Signal Corps, United States Army, cleared of one scientific contribution before another is crowding for recognition. Only recently, announcement was heralded of the development of a "superphone," whereby communications over ordinary telephone could be clothed in secrecy.

The demonstration to determine the efficacy of the electric lamp as a source of power for the interception of news, music, lectures, and speech was recently given in the office of the Chief Signal Officer of the United States Army. The performance was witnessed by Major General George O. Squier, Dr. Louis H. Cohen, a noted electrical engineer of the Signal Corps; R. D. Duncan, Jr., chief radio engineer, and S. Isler, assistant radio engineer, of the radio research laboratory of the Signal Corps, located at the Bureau of Standards. There were other spectators who marveled at the simplification of radio-telephony in terms of a conventional electric lamp, a household convenience wherever the services of electrical illumination are intrenched.

The group of listeners do not employ head-telephones for the reception of music or speech over the electric light line. These are easily dispensed with in this instance. Likewise, towering antennæ are not needed. The instruments consist of a radio-telephone receiver of a well-known type, with loud-speaking horn, which is suspended on the wall immediately above the receiving set proper. May it be said that any standard radio receiving outfit will readily lend itself to effective application for tapping electric transmission lines in this fashion.

This particular demonstration was conducted over a circuit one mile in length, with the radio transmitter at one end of the line and the receiving and amplifying equipment at the other, the latter being in the office of the Chief Signal Officer of the United States Army. Contact with an established electric transmission system may be made in one of two ways. The transmitting station can be connected between the two lighting mains of a city or the alternate of connecting the two mains to a condenser and employing them in parallel may be adopted. The latter procedure, according to Dr. Louis H. Cohen, an electrical engineer of the Signal Corps, probably offers superior advantages. The radio transmitter employed in the preliminary tests was of standard design as in use by the United States Army. The outfit was vested with five watts of power. The range of such a broadcasting service, quite naturally, is dependent upon the quantity of power employed at the transmitting station.

The receiving apparatus is provided with a detector tube, another unit for amplifying the music or speech being admitted. A high-frequency current, the backbone of "wired wireless" or "line radio," is introduced and modulated in the same fashion that speech over a conventional telephone line is negotiated. These modulated electric waves are propagated along the lighting circuit and tapped off at any desired point. A radio receiving outfit is readily connected thereto. It should be stated that the transmitting outfit is connected to one point of the lighting main and one point at the ground. The use of an antenna is altogether dispensed with.

The simplicity of this latest invention makes it a strong bidder for widespread popularity in the millions of homes lighted by electricity. The housewife, tired of hearing the buzzing noise of the electric sweeper or having grown weary of applying heat to the flatiron, may substitute these household conveniences alternately with soothing music or knowledge on current subjects by merely plugging-in the extension cord which connects to the simple radio-receiving instruments. A broadcasting service in every city where a network of lighting system permits is the ambitious program outlined by the inventor for "line radio." Major General Squier is quoted as saying: "'Wired wireless' or "line radio" will probably do more than any other thing to solve the problems confronting Secretary Hoover's radio conference. The congestion which has recently come about by the increase in the number of broadcasting stations promises to be relieved by this new use of "guided radio." The advantage of broadcasting over electric light wires is that it permits of a local service without exacting the penalty of broadcasting in space from the common antenna, which is now a subject for debate as to the confusion that is likely to result.

For the benefit of the absolute tyro it may be specified that the new system does not enable one to listen in on the broadcasting that is now being done. The lighting system takes the wireless impulses in tow only when it is properly in the broadcasting circuit to begin with, and this is not the case at present.

Stop! Look! Listen!

Automatic Device Slows the Train at the "Distant" and Stops It at the "Home" Signal

By John T. Bramhall

As long ago as 1879, Charles Francis Adams, Jr., while president of the Union Pacific Railroad Company, said, in his book, "Notes on Railroad Accidents," "The effort in America * * * has been directed toward the invention of an automatic system, which at one and the same time should cover all the dangers and provide for all the needs which have been referred to, eliminating the risks of human forgetfulness, drowsiness and weakness of nerves."

In 1907 the Interstate Commerce Commission appointed a board to carry out an inquiry which had been called for by Congress regarding automatic train-stopping devices. The report of the board (1911-12) said: "The information obtained from tests (of automatic train-control devices) leads the board to conclude that there are several types of apparatus and methods of application which, if put into use by the railroads, would quickly develop to a degree of efficiency adequate to meet all reasonable demands. * * * In many situations, under existing conditions in this country, the board is convinced that the use of automatic train stops is necessary to the safe operation of trains. * * * The development of the automatic train stop has proceeded far enough to warrant the expectation that by its use greater safety can be secured in the operation of trains. Railroads should be given to understand that the automatic train stop must be developed by them as rapidly as possible."

In April, 1916, following the Amherst, Ohio, wreck, the I. C. C. board of inquiry declared: "During foggy or stormy weather, when signal indications can be seen but a short distance, positive and definite instructions should be given prohibiting the running of trains at high speed. Accidents such as this may be expected to occur unless those in charge of the operation of this property at once take steps to see to it, by such check, observations, and other means as may be found necessary, that speed is materially reduced in foggy weather."

The automatic train control committee of the United States Railroad Administration reported, December 31, 1919, "that on lines of heavy traffic, fully equipped with block signals, the use of train-control devices is desirable."

Lastly, the Interstate Commerce Commission has definitely ordered 49 of the leading railroads to install the automatic stop at the densest points of traffic on their systems.

In anticipation of such a ruling of the commission, several automatic-stop systems have been developed and tested. It was during an inspection of one of these by the writer, who rode on the locomotive, that the following episode occurred:

"Yellow!"

The fireman, from his box on the left, called a warning to the engineer, as he had taken it from the signal post just coming into view. We were running into a city not a hundred miles from Chicago, on a down grade. A mile, or less, ahead, was the joint crossing of two busy passenger roads like our own.

The engineer, with hand on the lever, paid no heed. Was he asleep, or ill?

"Watch the air," he said, with eyes afront. The indicator suddenly dropped to 40.

"I struck the ramp at 50 miles," he said. "It was against the rules, and my air was cut off. If it hadn't been for the control, I would have gone on at 50 or maybe better, and likely enough have struck something worse than the ramp."

"But the ramp stopped you?" inquired the "deadhead" passenger.

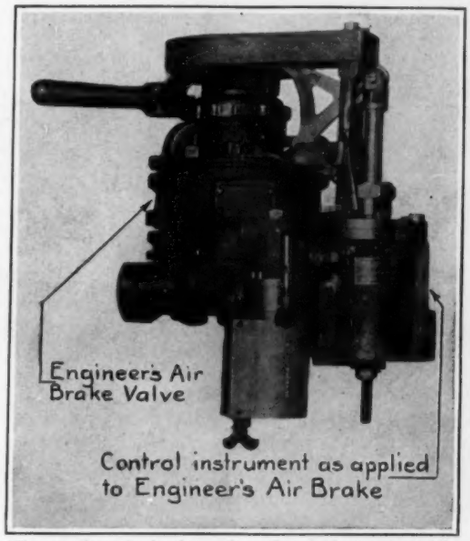
"No, it didn't stop me, it cut me down to 30 miles an hour. Now watch out, and if the crossing signal is against me and I don't stop, why, I get stopped, that's all," explained the engineer, with eyes on the road ahead.

"And if you get stopped," pursued the "deadhead."

"Why, if I get stopped," replied the engineer, patiently, as the home target showed clear, "that is, if the brakes are set by the valve outside there, why, I have to climb down and release, and it's me on the carpet next day. But if I get stopped, I don't run into anything. You get me?"

"And if it hadn't been for the ramp?"

"Heaven knows," replied the engineer. "You ought to see it work in a fog, or storm, when it's all we have to depend on. Here we are—so long."



The engineer's brake valve (in dark tone), with automatic control mechanism shown attached on right hand side

The above was an exhibition of the working of the Regan automatic train-control device at the request of the writer, who, having been told that the thing was impractical, wanted to be shown. The results were fully convincing.

The signals, clear, caution, or stop, are transmitted to the target, or semaphore, and are read and understood in the usual manner. The connection with the locomotive is made through a ramp, a single length of light rail beside the track, 150 or 200 feet in front of the target. The signal is seen by the engineer half a mile, in clear weather, before the ramp is reached, which gives time to slow down. A contact shoe, somewhat similar to that used on the electric roads, transmits the current from the ramp to the speed controller, which opens and closes electric circuits, depending on the speed of the train. This speed control may be set at any maximum desired.

The centrifugal member of the apparatus is a centrifugal governor, similar in principle to the centrifugal governor on a steam engine or phonograph. It is mechanically connected, for example, to one of the front wheels of the locomotive and revolves, therefore, at the same speed. This governor moves a pair of electrical contacts, opening them when the engine (and governor) speed exceeds a predetermined maximum, the "proceed with caution" speed for which the governor has been adjusted. These contacts, in turn, under certain conditions, control the air-brakes through an electro-pneumatic valve as follows:

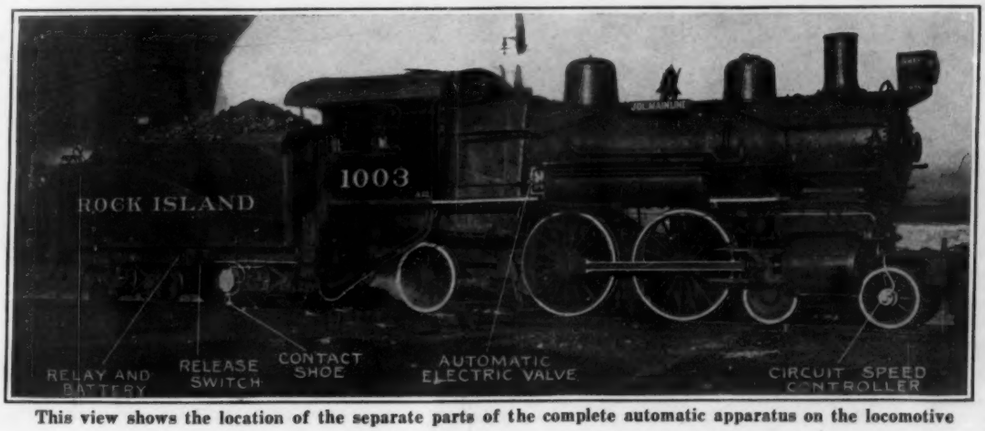
When operating on track between ramps, or when a "full proceed" indication is picked up through a ramp contact (or its equivalent, absence of cautionary signal), the electro-pneumatic valve controlling the air-brakes is energized by a storage battery carried on the tender, and the governor is not involved in the control. This is the condition when the train is running in a clear block.

When a train passes a signal in the caution position, the combined action of the control current received from the roadside apparatus and the change of electrical connections on the locomotive effected by the contact of ramp and shoe, inserts the centrifugal governor contacts in the circuit and thereby puts the air-brakes under its control. If the engine's speed exceeds the predetermined "caution speed" for which the centrifugal governor contacts are adjusted, the speed-governor contacts are separated, the electro-pneumatic valve is de-energized, brake-pipe vent opened and the brakes applied; at the same time the electro-pneumatic valve closes the reservoir supply to prevent the engineman from releasing the brakes manually.

When the speed of the centrifugal governor has been reduced to the point for which it is set, its contacts close once more and release the brakes by a reverse procedure. If the engineman allows the train to speed up once more while the caution indication is being received through the ramp, the centrifugal governor once more opens the circuit which controls the electro-pneumatic valve, which in turn controls the brakes, and the brakes are applied until the speed is reduced to the predetermined maximum, and then it once more releases them.

When a stop indication is received through the ramp, the electro-pneumatic valve-circuit is opened, external to the governor, and the brakes applied, irrespective of governor position.

It is important to note that the initiative remains with the engineer, and only when he fails to respond to a signal indication does the speed controller, obeying orders received through the ramp, do the work for him. The engineer cannot increase speed while the locomotive is in the low-speed area, nor, if brought to a stop by the ramp, can he proceed without descending and releasing the valve. If, on passing over the home ramp the stop signal is not given, he may proceed at schedule speed. No unnecessary stops are caused, and it is claimed that better time is made in bad weather with the aid of this device than without it. In answer to an objection that so delicate a mechanism as the speed controller attached to a locomotive journal would be liable to get out of order, it was said that one had been in service for about 75,000 miles, and another for 50,000 miles, without repairs. The entire cost of maintenance of the automatic control on this division in the initial operation of last year, I understood, was about half that of the interlocking signal and crossing protection, which it supplements and strengthens.



This view shows the location of the separate parts of the complete automatic apparatus on the locomotive

Examples of practical operation might be multiplied. The history of automatic train control is 20 years old. Among various forms of automatic train control mention may be made of that on the Chicago & Eastern Illinois (107 miles double track since 1912); Chicago, Rock Island & Pacific (21 miles double track since 1919); Chesapeake & Ohio (19 miles single track, with announced intention of extending installation eventually over the entire system); Western Pacific in California, and the Interborough electric lines in

New York. As a result of recent hearings before the Public Service Commission at Albany and the recent action by the Interstate Commerce Commission, it may be stated that the New York Central has undertaken a service test of a train-control device of the induction type on the Mohawk division, a test which is expected to set the pace for a standardization and general adoption of automatic train control on trunk line railroads.

It is quite unnecessary, I am sure, to bring forward any arguments, or to marshal statistics to show the urgent necessity of the adoption of some sort of automatic train control. That has been done on frequent occasions in the columns of this journal. Therefore, I shall not call the evidence of the all-too-numerous collisions and other forms of train wrecks and the thousands of lives annually sacrificed (and many thousands more maimed for life), of passengers and employes alike. The facts are admitted. The need of relief is recognized by the railroad executives, but they are between the devil and the deep sea. On the one hand are pressing demands for maintenance, improvements, rolling stock, motive power, and labor, which now claim first consideration instead of last. On the other hand, are the difficulties of raising money in the face of diminished earnings. Railroads are obliged to have money to operate, and they must operate profitably in order to get money. The management dreads collisions. Eventually we look for a rapid and widespread adoption of the automatic stop.

The ramps, one on each side of the single track. For one-way traffic only one of these 40-foot rails is necessary

Two-Cent Gasoline—A Pitfall for the Unwary Investor

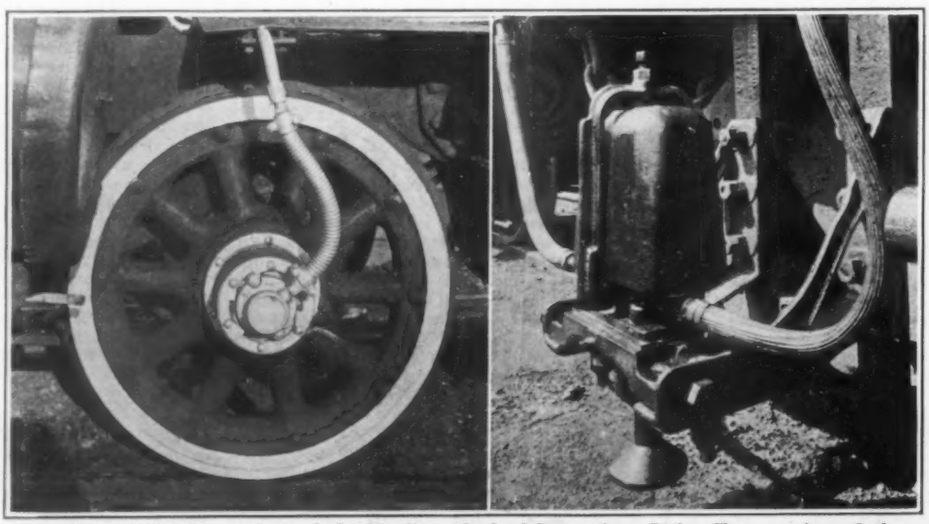
THE elements of comedy and tragedy were curiously combined in a Mineola, N. Y., court-room recently, when one of the most persistent of the "inventors" of synthetic gasoline had his day in court. This was the man whose mysterious green fluid, introduced into a mixture of water and peat, was claimed to result in the distillation of a motor fuel at a cost of two cents per gallon; and he has had a great deal of attention in New York papers and those of other cities as well. Sued for obtaining money under false pretenses, he arranged for a court-room demonstration, with the understanding that the case against him was to stand or fall in reverse ratio with his success or failure to make good on his claims. Needless to say, his "demonstration" was a complete failure, and the court refused to grant him another chance. Whether or not this "inventor" was a self-deluded visionary does not enter into the discussion of the many schemes which for the past eight years have been stimulated by the quest for cheaper gasoline.

Dr. Raymond F. Bacon, formerly head of the Mellon Institute, has devoted a large part of his professional activity for several years to the investigation of such claims. His experience is that the majority of the claimants are deliberate frauds and, within their abilities, tricksters as well. An oil which can be used as a motor fuel, he points out, can by well-known means be distilled from peat—but at a cost of several dollars a gallon. This lends peculiarly to fraud, since the prospective investor can test the performance of the alleged cheap fuel more readily than he can verify the statements made to him about its low cost of preparation. In spite of this, however, most of those who have played this variation of the get-rich-quick game have done so on a trifling scale, which involves actual sleight of hand in the performance test, rather than an above-board test of a fuel actually produced at excessive cost from peat, water, etc. "Inventors" of these "cheap fuels" are usually temperamental folk, who have to be left alone for a while at the critical point of the operation, in order that "the secret shall not be revealed" prematurely, or for some other entirely good (?) reason. It has been found that gasoline or tar oils of some kind are quickly substituted when no one is looking. One inventor had a still which he led his dupes to believe was producing gasoline out of a mixture of water and a white powder. As a matter of fact, he placed gasoline in a tank outside of the building where his experiments were conducted, and this fluid passed through the still from a hidden pipe. What was actually obtained was a good quantity of real gasoline which the promoter put in the tank of an automobile. Naturally, the mileage made by his mysterious fluid was about the same as that which could be obtained from any good quality of gasoline.

Another inventor told those whom he wished to interest that he could run an automobile with a mixture composed half of sea-water and half of a mysterious preparation of his own. He first put the sea-water into the tank of the automobile and put in an equal amount of his own fluid fuel. The car ran very well, for what the inventor put in was pure wood alcohol, and the resulting mixture, being 50 per cent alcohol, burned fairly well. In a similar case, but for the interference of a strong-arm man, who found that the inventor had under his waistcoat two rubber hot-water bottles filled with alcohol, the deception might have worked.

Some of the inventors of gasoline processes foist upon the public a mixture of kerosene to which is added a little ether. The effect of the ether is to give a quicker ignition, but as this fluid is very costly the motor fuel of this kind really costs more than the gasoline for which it is supposed to be a cheap substitute. Undoubtedly cheaper substitutes for gasoline will be made eventually and at the present time there are mixtures of alcohol and tar oils which although more expensive than gasoline have many good qualities.

It should be borne in mind that all the large petroleum refining companies are spending many thousands of dollars in research work in order to find lower priced gasoline or motor fuels. Any inventor, for instance, could interest the large corporations and perhaps reap a rich reward in royalties if he could convince them that his process would make gasoline at eighteen cents a gallon. The idea of manufacturing this fluid at two cents a gallon is a preposterous one, and beyond the realm of common sense. Any person who is considering the purchase of the patent rights of a process for making cheap gasoline would do well to consult a petroleum chemist, for past experience has shown that there are many pitfalls for the unwary into which those who are not familiar with chemistry are likely to tumble.



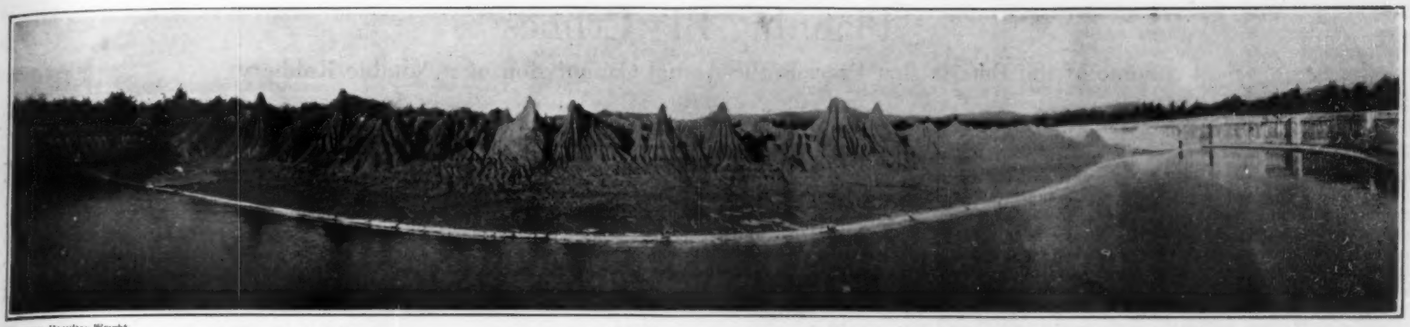
Left: **The centrifugal control attached to leading wheel of locomotive.** ***Right:*** **Close-up view of shoe which makes contact with the ramp**

The Sex Detector Exposed

NUMEROUS so-called "sex detectors" have been brought out during the past few months, in behalf of which the most extravagant claims have been made. These instruments have in almost every instance been plummets or balls of some sort suspended at the end of a string. One was of nickel-plated iron filled with a greenish mixture of calcium carbonate and an aluminum salt. Another was a small wooden ball, gilded and filled with red lead. A third was a slightly soft, slightly gummy composition of some unknown identity—solid or hollow we do not know, since the one we saw was not ours to cut open.

All of these devices "work" in the same manner. They are held at the length of their suspension cords above the object to be tested. If the verdict is "male," the bob is supposed to swing back and forth like a pendulum; if "female," to describe little circles at the end of its cord; if "neutral," like an infertile egg, the bob is supposed to stand motionless. There is no claim that is not made for the sex detector; it is alleged to indicate without possibility of failure the sex of an unhatched egg, of oysters, of butterflies, of beetles, of caterpillars, of worms, even of the animal from which products like leather or cheese come—though a verdict of "male" in the latter case would have its bewildering features. Even the sex of the person who had shed dried blood found on weapons or clothing was claimed to be instantly determinable.

It should hardly be necessary to say that there is absolutely nothing at all in this business. When the manipulator of the device knows the verdict which should be rendered, he consciously or unconsciously gives a muscular reflex that directs the bob in the appropriate path. When he is ignorant of the sex to be determined or of the motion which the bob is supposed to yield under known circumstances, either the detector stands motionless or achieves the 50 per cent of correct guesses to which it is entitled. Nor is the "detector" in the least degree consistent. Tests by different persons on the same group of eggs or other objects are widely discordant. In the absence of any scientific explanation of the alleged working of the apparatus no such investigation as this should be necessary to set the issue at rest; but query and credulity have been so persistent that the United States Postal authorities and the editorial staff of the SCIENTIFIC AMERICAN have both been driven to make the tests outlined.



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Guatemala's relief map, two acres in extent, that shows every topographical and cultural feature of the country

A Relief Map That Fills Two Acres

THE republic of Guatemala, in its endeavor to make it easy for visiting capitalists to see what they are investing in and to decide on the merits of proposed investments, has built and set up what seems by all odds the most extraordinary relief map in the world. This map is two acres in extent, and shows every contour, every town and every stream or lake in Guatemala and the neighboring territory of British Honduras. It is surrounded by water representing the Atlantic and Pacific Oceans.

The giant topographical map is of concrete, assembled in sections. Almost two years were spent in making the molds, and in checking them up. The ultimate cost of the map was $100,000, and another like sum was spent in gathering the topographical data on which it is based.

The big map is located in the hippodrome or racetrack at Guatemala City, and its substantial character is indicated by the fact that it has passed through two earthquakes without harm.

Moving a House of Glass

By F. G. Jopp

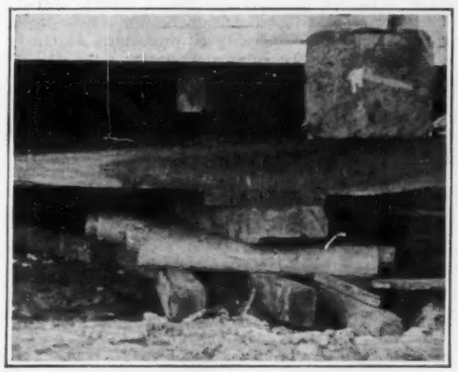
FOR two months recently one of the most delicate jobs of structural moving ever recorded was in progress at one of the big motion-picture studios in Los Angeles. It consisted of moving one of the huge glass stages—a shed-like structure, 50x150 feet, and containing 3384 panes of glass—across rough ground to the side of another similar stage.

In addition to the moving operation, it was also necessary to put the fragile structure in exact register with the other stage, in order to make the two into one complete studio.

It was first intended to demolish the stage; move the material; and rebuild the structure at the new location. About this time a local moving firm successfully transferred a complete hospital from one site to another without disturbing the patients, and the idea occurred to the motion-picture men to undertake the moving of this delicate glass affair, with no supporting interior walls, intact.

Because of the nature of the building, the task was made doubly hard. A glass studio consists simply of four walls and a roof. There are no interior partitions or supports to give it rigidity. When it is remembered that this huge building is 50x150 feet in size, it can be readily seen that the job of moving it was an undertaking of great delicacy, especially so in view of the fact that the four walls are entirely glass, pane after pane leaded together. A slight strain and hundreds of panes would be shattered. And, in addition, the huge affair had to be placed within a fraction of an inch of the desired spot.

The moving company first secured some extra long 12x12 timbers. Undermining the building, the timbers were run under the structure while the structure was still on its foundation. Jacks were then inserted under the long timbers at frequent intervals and a man assigned to each one. Slowly and carefully turning in unison, these men lifted the building about three feet above the ground. Meanwhile the picture companies were hard at work overhead in the studio.



A sharp turn in the track, showing the slant by means of which the rollers were constrained to follow the desired course

Lifted clear, the next step was to construct a special track, the idea of the foreman. He arranged this in such a way that the studio would, in its travel, follow the intended course, through the natural "roll" of the rollers on the track. In other words, the combination of leverages was worked out so that it took the place of flanges on wheels.

This done, the studio was let down on to rollers which were placed on the track. All was then ready for the actual moving.

One team of horses, with a windlass, was stationed at the point the foreman calculated was the proper place to give the right leverage for his tracking system. The horses were then started and the studio rode in perfect fashion to the exact spot calculated.

A structural steel section was then inserted between the two studios and the one that had been moved was lowered into place and the two riveted together.

Not a single pane of glass was broken in the studio and not for a moment was the work of production of pictures halted.

The resultant studio is 100x150 feet—one of the largest glass stages in existence. It will give a floor space of 15,000 square feet, unrestricted by beams or other hindrances. Thus the largest street scenes can be built indoors under the glass. The ingenuity of the moving concern accomplished in two months of leisurely work what would have required at least six months to do had the tearing-down and rebuilding been undertaken.

Photography of Stars in Full Daylight

IN *L'Astronomie* for October, 1921, is a short article by M. Maurice Hamy on this. Experiments were successfully made by Messrs. A. F. and F. A. Lindermann, in England, in 1916. They succeeded in photographing stars down to the third magnitude near midday and indicated their belief that fainter stars might be photographed quite near the sun in a fine climate, *e.g.*, in Kashmir or on Mount Wilson.

M. Hamy has performed numerous experiments with a small apparatus designed for testing the purity of the atmosphere at various localities. He concludes that with objectives of moderate aperture (as for example 13 inches) it should be possible to obtain clear images of stars down to magnitude 6, with an exposure of a half hour. Special plates, sensitive to the infra-red rays of light, and deep red filters to cut out all other colors, are required for this work and the atmosphere should be as free as possible from haze.

The particular problem to which this method may find immediate application is the testing of the Einstein hypothesis, that light rays are subject to deflection in passing through a gravitational field. The apparent direction of a star whose light just grazes the surface of the sun should be changed by nearly 2″. If this method becomes successful for the fainter stars, it will not be necessary to rely on the few minutes of total solar eclipses for testing the Einstein theory.

Left: Ready to start moving the huge studio building containing 3384 panes of glass. *Center:* Putting in the connecting link. *Right:* The two studios joined into one

Moving a film studio across rough ground and joining it to another, one of the most delicate jobs of structural moving on record

Planning Big Crimes

Some of the Details that Precede the Actual Commission of a Notable Robbery

By Roy A. Giles

THE commission that plans a city beautiful, the engineer who gives reality to a sky-scraper, and the inventor who evolves a wonderful new mechanism, plan no more carefully than does the "highmobsman" or master mind of a "gun mob" or gang of crooks. The recent $1,500,000 mail-truck robbery in New York, where the crooks had more definite information about the registered mails than the Postmaster General himself, and other crimes of an outstanding nature, would completely mystify one unfamiliar with crooks and their ways. However, here and in all other cases, there are certain marks which reveal to the skilled detective or criminologist just how the thieves set about their plans. Once one knows the cunning little ways of the brainier crooks it is plain that they do not go about a job without a very clear idea of what they may hope to get, and how they may expect to get it.

Planning a big robbery sometimes begins with a bar of soap—of which more later. Sometimes it begins with a pretty girl. Soap is put to many uses by the more accomplished crook; so are pretty girls—and girls who are not so pretty. Sugar is often added and served with the pretty girl, to corrupt someone from whom information is needed. "Sugar" in this instance does not mean something sweet; it is just one of many crook words for coin of the realm.

An outsider corrupted by thieves who need the information he can furnish, is an old, old story. Such a one is seldom if ever a real member of the band. He is the "sucker," the "simp," the "boob," the "hick"—or something equally uncomplimentary and less printable. He is milked of all needed "dope" and then he is often murdered. An instance of recent record is Benjamin Binkowitz, youthful bank-runner of New York, who was used as a tool by an Italian "mob" in the robbing of Wall Street brokerage houses of large sums in negotiable securities. His body was found, terribly mutilated, where it had been thrown against a wire fence from an automobile on a lonely Connecticut road. Binkowitz got the bonds, got the information as to when and where other runners might be intercepted with valuable loads; he had met his "pals" in a roadhouse near Bridgeport; they had given him one grand orgy, after the manner of the Camorra (Italian crook mob), with girls, music and "booze"; then they had taken him to his doom.

Girls are often used by crooks without their knowledge. I call to mind three show-girls who married handsome and seemingly refined men, to learn later that they were crooks. Many others have been used to get needed information about wealthy men or big business houses. These girls "vamp" their victim until he "falls" for them; then they work the information out of him in one way or another. Such information may be for use in a crime that is being planned, or it may be for blackmail. Some of the girls have no idea, at the time, of the purpose for which the gossip that they pass along is wanted. If the girl is actually corrupted and becomes a decoy, "stall," or tool for the crooks, either for the sake of a man or for money, that is another matter. Then she becomes a "gold-digger" and often becomes a bit of a crook on her own. Sometimes she succeeds in keeping within the law; again she slips all the way down to the bottom rung of the social ladder and finally fills the grave of a drug-crazed suicide.

There is the notion that the girl crook is peculiarly liable to turn state's evidence on the arrest of her male pal. And there is the idea that the girl in the case would rather die than aid justice. Both ideas are right—and both are wrong: it all depends upon the girl. There are all kinds of girls, and all are peculiar; Adam was probably the first man to observe this. The only way to tell how the girl in any case will behave is to try her, and see.

Some of the crime cases which I can call to mind are so intricate, so weird and so startling that I know how to account for the use of superlatives in the newspapers. However, the papers seldom print all the emotional and psychological facts back of a crime, unless it be a murder with sex interest; from day to day they pass from crime to crime, and space is too valuable to tell any of the stories in detail.

Probably the most carefully planned and unusual item in American crime annals is the story of one of our large northwestern cities, which for some time was administered by and for the crooks. It wasn't Duluth and it wasn't St. Paul; so we may refer to it as Dupaul. Some time before the commission form of government became prevalent, certain crook mobs were "making" the cities between the Lakes and the Coast, under such official protection as was available. These gentry decided that they ought to have a real base, where protection would be surer and official graft not so profiteering as it is apt to be when it crops out spontaneously. In the conspiracy which was cooked up there were a gang of strong-arm workers, one of pickpockets, one of second-story workers, one of shoplifters, one of "fences," a gambling ring, an army of women directed by a competent "mouthpiece" or lawyer, a group of badger workers—and others too numerous to catalog. They were all good spenders and they all made friends around Dupaul. They finally succeeded in electing their mayor, whose life in and out of jail is now a matter of court and police record. Strong for lewd women and graft money, he was a near-crook, a crook sympathizer and a crook protector. As mayor he saw to it that the chief of police was the "right" person. The force itself was made up of low characters, grafters and riff-raff generally. A white girl or a white 50-cent piece was as safe in the hands of that police force as a mouse would be in the claws of a starving cat.

In those halcyon days for the crook mobs of Dupaul the police used to seek out the places to be robbed and stand "stall" or look-out during the commission of the crime. If no truck was handy they would call out a patrol wagon to take the loot away. Safes were carried off bodily and blown open in the railroad yards. If a citizen happened along and tried to interfere, some near-crook picked a fight with him, and after he had been well beaten up he was jailed for creating a disturbance. Nearby thrifty towns were raided and money rolled around the underworld of the metropolis of crime like hailstones during a storm. Occasionally, by way of diversion, a train robbery was indulged in. One Great Northern express hold-up netted more than a million dollars in gold bullion. The stuff was carted into saloons and hidden behind bars. Bartenders had hack-saws handy, and when a crook needed funds they would saw off a chunk of gold about as a housewife would slice a loaf of bread for little Johnny and sister Sue.

Finally the Federal Government went into the crook-ridden city and, with the aid of the honest element, there was one grand round-up. A choice assortment of city officials was included in the group that went to the penitentiary. Those who escaped fled to Denver and tried to get control there, but were not able to make it go. One of them served a life term for the murder of a Denver policeman, another "got his" for a 10-year stretch in Canada, and the crowd was finally thoroughly broken up.

One little incident in the crook administration of another town is worth telling. One night they wanted to rob a bank. To attract the townspeople from the section where the bank was located they got the fire chief to start a nice large blaze in another part of town. The fire chief out-Neroed Nero. He couldn't play the violin, but he came pretty close to burning up the city. With some of his followers he later took up residence in another part of the State, where the styles run to horizontal stripes. The school director, however, was a luckier or a better man; he outlasted the fire chief by 15 years, during which he maintained an exterior of the utmost piety and honor while hiring cracksmen to rob the school treasury in his interest. He was prominent in the church and the Sunday school, and director in a couple of banks. The banks blew up when he blew.

One city which we may fairly name here is Peoria. Because of its strategical position between Chicago and St. Louis, it is the handiest place in the world for a big-town crook to be able to lay up in, and the crooks of Missouri and Illinois are always casting hungry eyes upon the city government. Peoria in fact has had its ups and downs in dealing with this situation; but finally, in Mayor Woodruff and Police Chief Rhodes, they found the proper combination to deal with the menace. They reelected this pair for a succession of terms over a period of 18 years, with the ultimate result that Peoria had to close its workhouse for lack of patronage; and the town is now as clean as a pearl.

One bright afternoon a tall, handsome fellow walked into police headquarters in Denver. He was from the Coast, and had a line of talk which supported his claim of intimacy with many detectives and patrolmen in San Francisco and Los Angeles. He made himself liked, and after he had got a good job he continued to put in his spare time around the police stations.

This fine chap's name was Hastings, and he had just finished a sentence at San Quentin for bank-robbery. He was not of the safe-cracking type, but depended on his brains to get the money, and he possessed ingenuity and persistence worthy of a better cause. All by himself he reconnoitered the Denver banks. He finally selected Elwell's private bank as his victim. He laid swift court to a young widow employed here, married her after a few weeks, and then for a couple of months was with her about the bank as much as possible, while keeping the marriage secret so that his wife might retain her place.

Sometimes in his capacity of his wife's gentleman friend Hastings actually waited on customers of the bank. Learning that there were two keys to each safe-deposit box, one held by the bank and one by the box-owner, and that both were necessary to gain entrance to the boxes, he made a bar of soap a permanent part of his equipment. He took soap impressions of all the bank's keys; and when patrons came in he would ask to see their keys for a moment for verification and thus have opportunity to get impressions of them, too. With a "pal" who had shown up from "back home" and who posed as the son of a prominent family in Southern California, he fashioned duplicate keys and planned the robbery.

The "son" of the prominent family called on Elwell when he was alone in the bank, "to rent a safe-deposit box." Hastings was waiting just out of sight with his bunch of keys. When Elwell turned his back to his prospective patron for a moment, he received a clout back of the ear with a blackjack. But an accident saved the day for law and order; the blackjack broke and spilled shot all over the place, the blow failing to do more than arouse Elwell's fighting blood. The banker weighed nearly twice as much as the crook, and when detectives arrived in response to a burglar alarm the Californian was thoroughly subdued, with Elwell sitting on his chest. A confession was followed by the arrest of Hastings and his conviction.

Soap, used more or less as Hastings used it, is one of the crooks' stand-bys. A few underworld characters once robbed the New York sub-treasury of somewhere between two and five hundred thousand dollars, in gold bullion, by using only what brains they had, plus a cake of soap. "Red" Dugan planned this robbery, which was a gem. He located a place where sub-treasury employes ate and drank; and here, with a small bar of soap concealed in his palm, he stumbled against one of these workers. Apologies were offered and accepted; but in the meantime, during the collision, Dugan had pressed his soap against the other's badge and got an impression thereof. From this he had beautiful sub-treasury badges made for all his band, including a well-known forger whose services were necessary. By corrupting a waiter in the restaurant he succeeded in buying advance information as to when a shipment

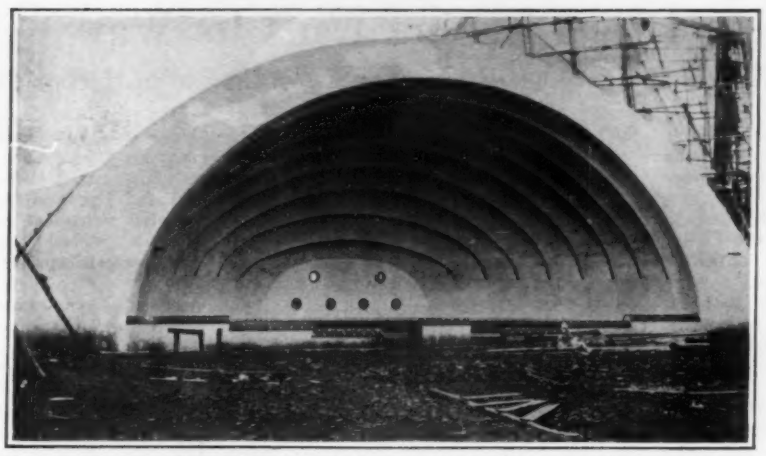
(Continued on page 434)

IF we were asked whether the subject of this article is in our field, the answer would doubtless have to be "No." Neither was Mr. Giles' story "Science in Safe-Breaking" in our December issue; or Dr. Simon's article "From Opium to Hash Eesh," in the November number; or our account of "Stamp Frauds and Their Detection," in the January issue. But all of these articles aroused wide interest and evoked a good deal of comment; and, in a way, it is appropriate for us to tell how science and scientific methods are used in the commission of misdeeds. So we have had no hesitation in putting the present interesting story before our readers.—THE EDITOR.

Outdoor Auditoriums of Novel Design

THOSE of us who have ever spent a summer or a part thereof at Chautauqua, N. Y., or at any of the little Chautauquas in other parts of the country, are sufficiently aware of the fact that an auditorium does not necessarily have to possess a full complement of four walls and a roof. Performances are being given, and exhibitions held, more than ever in structures to which the adjective open-air may fairly be applied. And the architecture of these buildings displays a surprising possibility of variation.

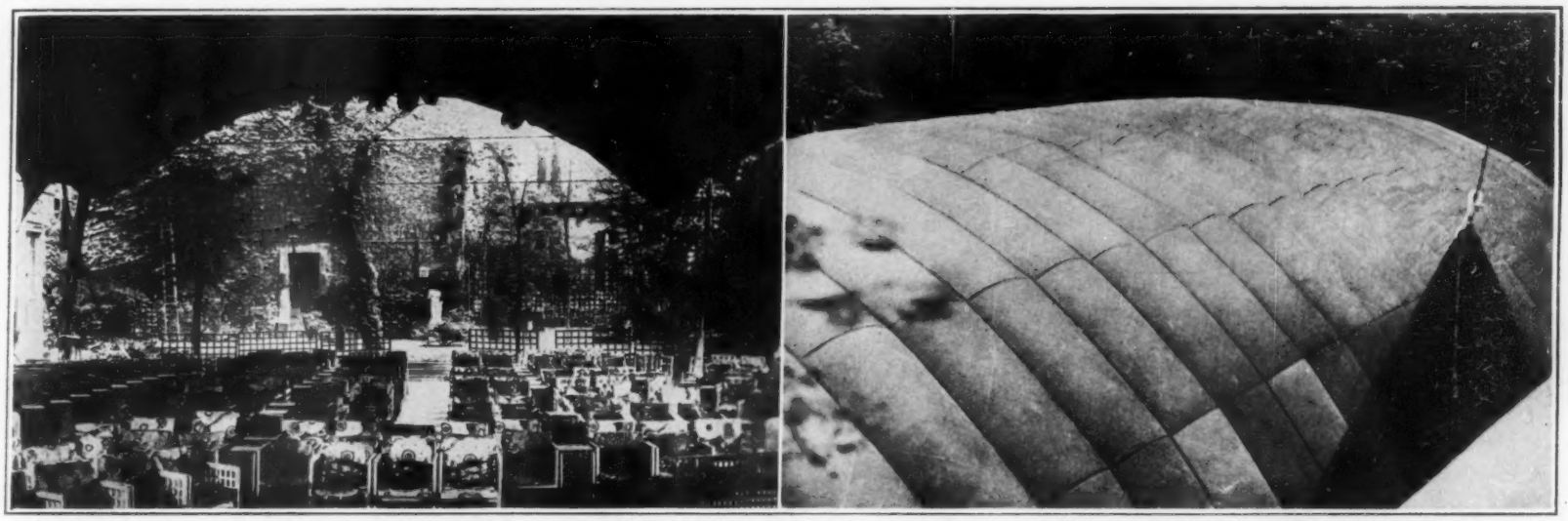
Tokio, for instance, has been holding a Peace Exhibition; and it was desired to have an open-air auditorium for concerts and similar performances. Provision is in this instance made for sheltering only the performers; if it rains, the audience must get wet or go home. The stage structure is of concrete, laid on bamboo forms in the shape of a multiple-arched vault closed at the back and sides save for a single entrance-and-exit door at one side. It is wide open in front, and one can imagine that it acts as a remarkably efficient sounding-board, making the performance audible to an extraordinarily large audience.



Vaulted stage and sounding-board of concrete in which open-air concerts are given at Tokio

Another interesting construction is the bamboo-and-glass shed in which was housed China's first automobile show, recently held at Shanghai. Motor-car manufacturers from America, Great Britain, France, Germany and Italy were among the exhibitors; but to an automobile-surfeited public like that of America, by far the most interesting feature of the exhibit is the building in which it was held. This was apparently put up for the occasion; our photograph shows it in process of erection, and makes it almost unnecessary for us to comment upon the manner of its construction. The roof and walls are in part of the matting shown piled up on the floor, but in large part of glass. The notable feature of this construction would appear to be the size of the building which can be put together over a framework of such small-caliber members.

The most surprising of the views on this page, however, are the exterior and interior shots of the Oasis Theater in Paris. This is a genuine open-air proposition, in that the performers and the audience alike are located out of doors. In fine weather there is nothing to the theater but a floor and seats. When it rains, a huge pneumatic hollow rubber roof is rolled into place over a light framework that surmounts the floor, and blown up just like an automobile tire.



A Paris theater with a pneumatic roof that is put in place and inflated when it rains. The two photographs show this novel roof from within and from without

Shanghai's bamboo shed of automobile-show proportions

Don't Paint Your Oil Tank Red

"PAINTING the town red," is an imaginary condition of fascinating appeal to the adventuresome spirit. Similarly, using a brilliant color to decorate tanks and reservoirs for storing oil from gushers in the oil fields has added zest to the building of fortunes from gasoline, but the practice has proved to be a costly one. White paint as a covering for oil tanks is less ornate and not as stimulating to the eye but it reduces the losses of the crude oil from evaporation, if we are to accept the word of no less an authority that the Bureau of Mines, United States Department of Interior. This government bureau recently conducted a series of tests which developed this interesting conclusion.

Evaporation—to fly off into vapor after the oil has been taken from the ground—is the biggest loss sustained by prospectors once they have robbed a gusher of the valuable liquid. A government estimate places this wastage at 122,100,000 gallons a year, which, computed in terms of 22 cents a gallon, has a valuation of $26,880,000. This loss represents 3 per cent of the entire gasoline production of the United States from all oil fields and other sources. Observations have shown that a 250-barrel tank, maintained for five days in the summer, will be robbed of 2.8 per cent in volume by evaporation. The loss in winter, of course, is not so heavy, being not quite 2 per cent of the volume in storage. Records kept of the losses sustained by eight 55,000- and 37,000-barrel steel tanks in Texas approximated 5 per cent during the first two years after storage.

Various methods have been devised for curtailing this drain in recent years, notable among the discoveries being that an all-steel tank of gas-tight construction is the most efficient container for oil. That the color of the paint used in covering these tanks is an influential factor in increasing or diminishing the toll paid to vapor is one of the recent findings that will ultimately contribute to the efficiency of preservation of our gasoline supply. Tests by the Bureau of Mines have demonstrated that oil containers painted white average from 1 to 1½ per cent less loss from evaporation than tanks decorated with red paint. Black paint is even more costly as a contributing factor to wastage, taking a toll of 2½ per cent more than white paint. The explanation for this difference is that dark-colored paints absorb heat to a large degree.

Small tanks containing benzine were decorated in varying colors (gloss finish) and subjected to the influence of a powerful arc light for a period of fifteen minutes. The rise in temperatures at the expiration of this time showed the following results with respect to the color of paint or covering: Tin plate, 19.8 degrees Fahrenheit; aluminum paint, 20.5 degrees; white paint, 22.5 degrees; light-cream paint, 23 degrees; light-pink paint, 23.7 degrees; light-blue paint, 24.3 degrees; light gray paint, 26.3 degrees; light-green paint, 26.6 degrees; red iron oxide paint, 29.7 degrees; dark prussian blue paint, 36.7 degrees; dark chrome green paint, 39.9 degrees; black paint, 44 degrees Fahrenheit.

The conclusions of these experiments indicate that tin plating and aluminum paint were the most efficient in withstanding the aspirations of the thermometer. These products, however, are not adapted to use as outside covering. Iron coated with tin yields readily to corroding influences, and aluminum paint very soon robbed of its gloss becomes flaky. The results of these tests indicate that the rise in temperature of the benzine in the tank painted black was 31.5 degrees Fahrenheit greater than the rise indicated in the container having a white covering. Allowances should be made for laboratory experiments when the results are taken and applied to the conditions of the oil fields, but the advantage of painting oil tanks white is obvious.

Diesel Engine Wins Its Way

Substitution of Heavy Oil Engine for Steam Engine in Harbor Lighter

A NEW type of harbor freighting equipment which will have an important bearing upon cargo handling, and will ultimately effect a considerable reduction in the cost of freight transferred by water, has recently been put into service. We refer to the derrick lighter "Worthington," which is propelled by a Diesel oil engine, and is the first of its type ever built. It is unique among harbor freight-handling craft for the reason, also, that the power for propelling the boat, operating the freight-handling derrick, lighting the vessel, etc., is also obtained from Diesel oil engines. For many years the company, after which the boat is named, has operated in this harbor and tributary waters a large steam derrick lighter. This service is of such a character as to involve large standby fuel losses, for the reason that the boat has to be alongside docks or ships for a large part of the time, during which time fuel must be burned constantly to keep steam in the boilers. In designing the new vessel, it was decided to take advantage of the economies made possible by the heavy-oil engine, provided it were designed in a qualified form adapted to this particular service; the designers realized that not only would a Diesel lighter have no standby losses, but it would produce much more power per pound of fuel used than is possible with the steam engine. The steam lighter must keep its furnaces going day and night; the Diesel lighter consumes not an ounce of fuel while it is lying idle.

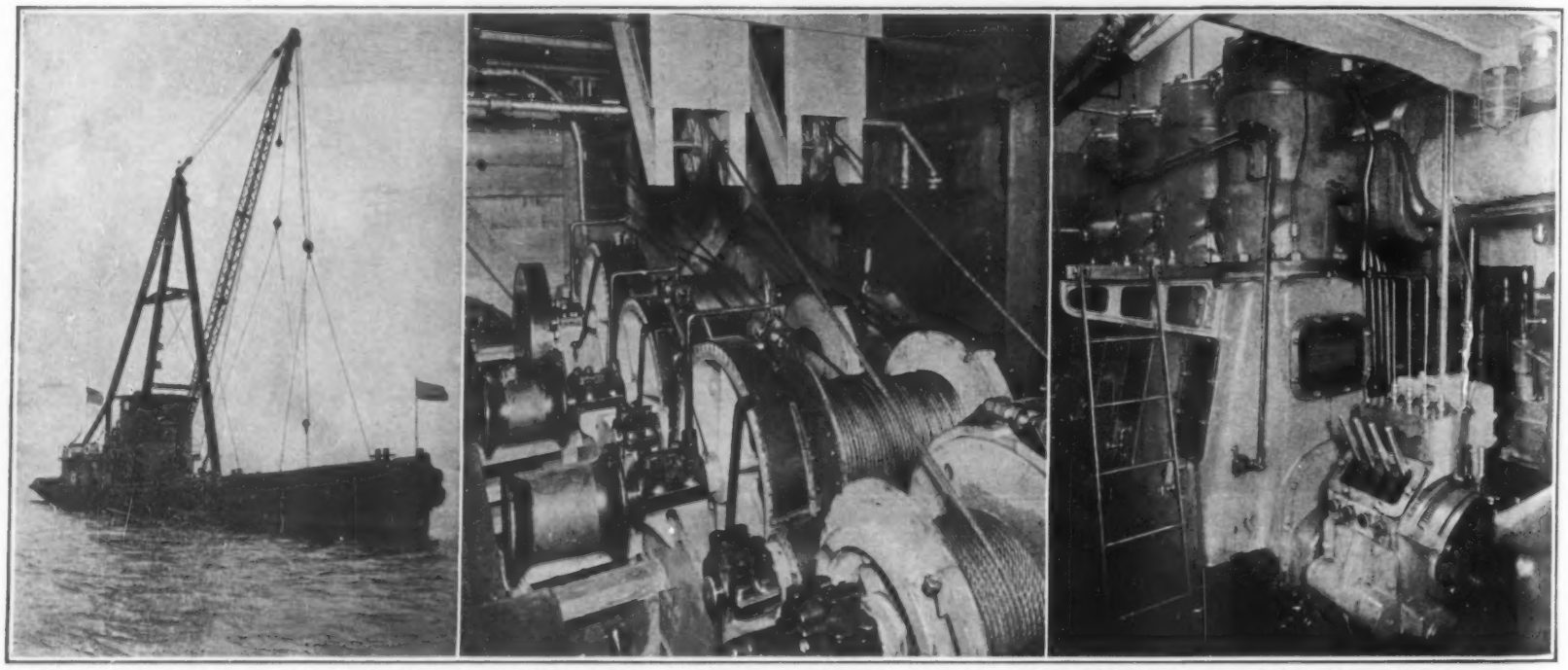
The "Worthington" is a wooden vessel, 138 feet long, 35 feet wide, and of 10 feet draft. It is built very heavy, to withstand the hard usage incident to service around the crowded docks of New York harbor. Her outstanding feature is the steel derrick of 20 tons lifting capacity, whose boom, 90 feet long, is stepped on a tripod 7 feet above the deck. The great length of the boom permits the boat to lie alongside high-sided ocean ships, and handle freight directly to and from the ship's decks, without calling upon the ship's own cargo-handling equipment.

The main engine for driving the vessel is a 2-cycle, 4-cylinder, reversing Diesel engine of 300 horsepower, built by the company from its own designs. It is direct-connected to the propeller shaft. A 2-cylinder, 50-horsepower engine drives a 38-kilowatt generator, current from which serves to operate the derrick, all the auxiliary pumps, the electric lights, etc. For lighting the vessel when the larger auxiliary is not in operation, a small Diesel engine operating a 6-kilowatt generator is provided. The hoisting equipment is located in the hold just forward of the engine room, and the wire cable from each drum is led by means of pulleys up through the deck to its proper connection on the derrick. We present an illustration of this hoisting equipment, with its winding drums, brakes, and friction clutches. The control is from a glass-inclosed operating room, placed at a good elevation in the forward end of the deckhouse, immediately below the pilot house. The hoisting drums are operated by an electric motor, and therefore the starting and stopping are effected by a controller, similar to the ordinary street car controller, located in the operating room.

The use of oil results in a degree of cleanliness and comfort in both the engine room and living quarters, that is unusual on harbor lighters. Furthermore, the consumption is so moderate that the boat has a larger radius of action without re-fueling, than is possible with the steam lighter. Fuel may be taken on at the most convenient time or place. Since boats engaged in freight lightering are essentially rovers, they are liable to find themselves successively at many different points in the harbor or adjacent waters. If a Diesel engine lighter is in the vicinity of an oiling station, fuel tanks can be quickly filled, and since fuel consumption is so small it is rarely, if ever, necessary, as in the case of steam vessels, to interrupt a job to go after fuel.

The steam lighter possessed by the company is of the same size as the new Diesel lighter, although its derrick is only about one-half the capacity. Hence, it is possible to get a direct comparison of fuel costs for the two boats. Taking an average month, during which the boats were under way 59 hours and tied up to the docks the remainder of the time, the coal bill for the steam lighter was $410.00; whereas the new lighter will give the same amount of service on a fuel bill of $250.00. This means a saving of 39 per cent of the fuel bill, to say nothing of the reduced wages due to the elimination of the firemen.

The engines of the vessels are of a new and simplified design. In starting, by a simple movement of a hand lever, the engine is turned by compressed air, just as the automobile engine is turned by its electric starter, until self-ignition begins in the cylinders. It should be noted that the boat was brought from the builder's yard to deep water in Delaware Bay, through the shallow and tortuous channels of Missapillion Creek, under its own power—a trip which called for six days of almost constant maneuvering with the main engine. Reaching the open sea, the vessel was navigated satisfactorily in mid-winter on a continuous trip from the Delaware Capes to Sandy Hook.



Left: New lighter "Worthington:" first to be driven and operated by Diesel engines. Horsepower, 300. *Center*: Electric motor-operated hoisting engine which controls all derrick operations. *Right*: Starboard side of engine, showing control assembly. All operations controlled from this point

A lighter that is driven by a Diesel engine

Glass That Is Opaque to the Ultra-Violet

RECOGNITION is being given these days to the invisible portion of the spectrum, which is known to exceed greatly in range the section to which the human eye is sensitive. Indeed, the ultra-violet and in less degree the infra-red waves partake of most of the characteristics of light, and are distinguished from it, if properly at all, by the mere accidental fact that our eyes are so built as to receive sensible impressions only from a short region toward the middle of the spectrum, from red to violet. Photographs can be taken with the ultra-violet rays, the light of the mercury-vapor lamp is extremely rich in them, and they have a powerful effect upon living cells. Certain animalculæ which will survive exposure to violet light for four or five hours are killed by the ultra-violet within fifteen seconds. The effect of these rays on the human skin, eye, etc., is different only in degree and in no sense in kind.

It therefore becomes an object to screen off these rays from ordinary light, if this can be done. The familiar fact that glass of appropriate color can be found to screen off any desired portion of the visible spectrum lends hope that substances may exist transparent to the visible wave-lengths but opaque to the ultra-violet. This hope is realized in a substance which is now being marketed in England after extensive tests by numerous prominent scientists. It is anticipated that this substance will play a very important part in the future development of the optical industry and particularly of cinematography, as by its use the ultra-violet rays are absorbed and at the same time there is no interference with the natural and useful light rays. It is a well known fact that in cinematography the light employed either in taking the film or its subsequent display, contains an abnormal amount of ultra-violet light, and both for the artist and the spectator a good deal of injurious mischief is caused to the eyes. By actual tests that have already been made and demonstrated in studios and in cinema theaters, with the new glass, it has immediately been noticed that through the absorption of the ultra-violet rays the eye strain and fatigue has been considerably lessened, and, in many instances, a complete restful effect has been noticed.

As indicating the performance of this glass, the result of a specific test is given. A sheet of the glass 2.24 millimeters in thickness was employed, and in the interval between 0.000,036 and 0.000,03875 meter, 28 determinations were made, at approximately equal wave-length intervals. This section of the spectrum corresponds roughly with the dividing line between visible and invisible, though of course no exact line of demarcation can be drawn, since individual capacity for perceiving the extreme violet end varies. For the shortest waves in this interval transmission was about 3 per cent; for the longest, about 88 per cent; and the variation between the two readings cited was approximately uniform.

Windproof Plate Glass Windows

NEW YORK and other large cities have had abundant experience going to show that the force of the wind is extraordinarily increased as it swirls about sharp corners and through narrow streets, and that no ordinary plate-glass window is safe against breakage in heavy storm. The trouble with the modern shop window lies in its size. A bridge of glass 12 feet or more in height and 20 or 30 feet between moorings has to support as a bridge the actual pressure of the wind; and, in addition, it has to withstand the shattering tendency of the vibration which the erratic gusts set up in the sheet itself. To meet the latter condition, which is regarded as the more serious of the two causes of breakage, is the object of the simple little attachment which we illustrate. This consists merely of several arms of metal which project down from above, curl forward toward the window, and bear upon it with surfaces of felt fastened over their metal ends. This effectually checks vibration and greatly reduces the probability of the window's finding the weather too severe for it.

The little protector, in place, that prevents vibration and resultant shattering of plate glass in high winds

Logs of Plaster for the Motion Pictures

By Frank B. Howe

THE seemingly paradoxical industry of making logs out of plaster is the latest innovation in commercial enterprises. Undertaken because a motion picture company required a quantity of logs for use in a picture, and conditions of distance and rough freight handling prevented the use of the reality, a complete success has been made of the plaster-log industry, which was invented to fit the occasion.

The making of logs from plaster is the invention of the Louis B. Mayer studios in Los Angeles. A rough chicken-wire frame is first constructed and coarse mortar worked around this in the general shape of the log. When this is dry, a fine plaster is applied to the exterior by hand, the final shape of the log being fashioned at the same time. When this is dry, a special paint is applied over the whole thing. A second darker coat is applied where the supposed bark is to come.

This done, the intricate part of the work is reached. With a sharp knife the cracks of the log are cut into the soft plaster exterior by hand. The log is then given a final coat of paint, and it is impossible to tell the plaster log from a real one by observation.

The unique industry has attracted much attention and interest in southern California, and the requirements of the various motion picture producers for logs of one sort or another insures a steady market for the product. Instead of having to import his logs from Oregon—a thousand miles away—with extreme care in handling so that the delicate bark will not be marred, the director can phone today for so many plaster logs and have them delivered the second day after.

Three stages in the manufacture of plaster logs, a trade to which the motion picture studio has given birth. Logs of plaster are cheaper than the real thing brought a thousand miles from Oregon

Improvement in Quality of Rare Metal Thermocouples

TESTS made by the pyrometry laboratory of the Bureau of Standards early in 1921 revealed the fact that many of the platinum-rhodium thermocouples found on the American market were subject to large changes in indication after long-continued exposure to very high temperatures. The wires from which these thermocouples were made were obtained from two sources, one American and one British. The tests showed that the former satisfactorily met all industrial requirements as to constancy and reliability if properly protected by well-known methods of insulation. The British refined metals and alloys were found to be subject to large changes in their indications because of exposure to high temperatures. Chemical and spectroscopic tests revealed the fact that the trouble was due to the presence of several tenths of a percent of iron in the platinum-rhodium alloy wire. The platinum wires, on the other hand, were found to be of high and satisfactory degree of purity. The facts developed by these tests were immediately communicated to the firms engaged in refining the metals used for thermocouples as well as to manufacturers of pyrometers who were employing them in their pyrometric installations. As a result of these tests, the British firm has located the seat of the difficulty, and is now marketing thermocouples that are satisfactory in all respects.

The superphone for wired wireless conversation

A New Telephone Invention

A DEMONSTRATION was given recently in the office of the Chief Signal Officer of the United States Army of a new telephone invention, the "Superphone," which has been developed under the direction of R. D. Duncan, Jr., chief engineer of the Signal Corps Research Laboratory, at the Bureau of Standards, assisted by S. Isler, assistant radio engineer.

The new device is based on the original invention, about 10 years ago, by Major General George O. Squier, Chief Signal Officer of the Army, of "wired wireless" or "line radio." It consists of a small portable set of instruments which may be installed in any office or residence in a few minutes and connected directly to existing telephone lines, and conversations carried on in the usual way. It will be necessary only for the subscribers to close a switch or press a button to connect in the superphone in place of the ordinary phone.

This superphone provides a means for secrecy of communication without any chance of the conversation being overheard, interrupted or broken into on the line by any one else. It is obvious that this invention will prove of value for military purposes in case of war, where secrecy in communication is absolutely necessary. It may also prove of utility for ordinary commercial purposes where important business houses, such as banks, brokers, etc., may desire to have private channels for confidential communication with their branch offices or with any business establishment, and insure secrecy of the conversations carried on.

The principles involved in this invention are those of "wired wireless" by which high-frequency alternating currents are employed which are modulated at the transmitting end by speaking into an ordinary microphone and detected at the other end by the usual radio instrumentalities which finally pass on to an ordinary telephone receiver. The speaker, however, or the listener-in, is not concerned with any of the additional instruments; they are installed and properly adjusted once for all, and the people carrying on the conversation have no more bother than in the use of the usual telephone system.

Another advantage of this method of telephone communication is that it makes multiplex telephony possible. A number of secret telephone conversations may be carried on simultaneously over the same line without interfering with each other.

The transmission of speech by the utilization of this invention is even clearer than ordinary telephonic speech.

The power required for carrying on conversations over even considerable distances is of the order of one-tenth of a watt, which is about 1/500th of the power required to light an ordinary electric lamp.

Severn Tunnel Ventilation

NEW ventilating plant is being provided by the Great Western Railway for the Severn Tunnel, England, the increase of traffic necessitating an installation of greater power.

The new fan will be 27 feet in diameter and 9 feet wide, and working normally at 100 r.p.m. will supply about 800,000 cubic feet of air per minute. It will be driven by a horizontal tandem compound condensing engine of about 800 indicated horsepower, having cylinders 21 inches and 42 inches in diameter with a stroke of 39 inches.

Left: Stern view of 23-knot armored cruiser "Lancaster" of 9800 tons. *Right:* Part of the double bottom (all that is left) of the 25½-knot, 17,250-ton, battle cruiser, "Inflexible"

Reducing Dreadnoughts to Scrap Metal

What the British Have Done By Way of Disposing of Their Obsolete or Discarded Fighting Ships

By Hector C. Bywater

ONE of the most difficult problems confronting the British Admiralty at the end of the war was how to dispose of the many hundreds of fighting ships that were no longer needed. With the dispersion of the Grand Fleet and the calling home of numerous squadrons which had been guarding the sea routes all over the world, every naval port became congested with redundant ships. Scores of battleships and cruisers, hundreds of destroyers and smaller fry, were left to rust at their moorings. Some had a few men on board to keep essential fittings in good condition, but the majority were deserted. These long lines of unwanted ships made a melancholy spectacle. Comparatively few were obsolete in point of age. Many had been launched during the war period, and had thus been in service only three or four years, but as they were in the official phrase, "surplus to post-war requirements," they simply had to be scrapped. Since they could not be left indefinitely at the naval dockyards, taking up valuable room and impeding traffic, there was nothing for it but to sell them as junk. Shipbreaking is quite an old-established industry in Great Britain, dating from the "wooden wall" era, when old line-of-battleships and frigates were demolished for the sake of their timber and metal fastenings, for which there was a good market. New methods had to be adopted when the wooden ships gave place to ironclads, the first of which came into the shipbreaker's hands during the 'eighties of last century. Business in this line was particularly brisk after 1905, following Lord Fisher's clean sweep of ineffective material from the Navy. But never before had scrapping assumed such dimensions as in the three years subsequent to the armistice. Some idea of the magnitude of the process was conveyed by an Admiralty announcement in May of last year, that 113 warships—including 5 battleships, 12 cruisers, and 75 destroyers—had been sold in one block to a single firm, Thos. W. Ward, Ltd., of Sheffield. Of late, however, there has been a distinct falling off in the demand for obsolete ships. Not only have British shipbreaking firms bought all that they can deal with for some years to come, but the depressed state of the iron and steel trade has reacted on the scrap-metal market, making it difficult for these firms to continue their breaking-up operations on a profitable basis. In these circumstances the Admiralty has had to sell ships abroad. Many have gone to Germany, where scrap steel is badly wanted, and down to the end of January nearly 200,000 tons of obsolete British war vessels had been purchased by German firms. Thus, by the irony of fate, the British Navy is contributing directly to the restoration of German trade. With the entry into force of the Washington naval agreement, which calls for the immediate scrapping of 20 British capital ships, a considerable addition will be made to the surplus naval tonnage now awaiting disposal. Most probably, however, the ships in question will merely be disarmed and otherwise dismantled in accordance with the rules laid down in the Treaty, and then put aside for breaking up at a more convenient time.

So far as the British shipbreaking industry is concerned, the methods in vogue are comparatively simple, and much the same whether the job in hand is the wrecking of a dreadnought or a destroyer. Briefly, the procedure is as follows: As a general rule the naval authorities remove all guns, mountings, and ordnance equipment, together with confidential instruments and fittings, before the ship is handed over, though in some cases only the light equipment is taken out, the armament itself being left in place. The vessel is then towed away to the shipbreaking yard. This is a somewhat hazardous operation in the case of a battleship or other heavy vessel, for the removal of so much weight has greatly reduced her draught, and in this light condition she is apt to become unmanageable if heavy weather is encountered. It is quite a common occurrence to hear that a vessel has foundered or gone ashore while on the way to be broken up. Nowadays, practically all shipbreaking in Great Britain is done on an open foreshore, docks being but seldom taken for the purpose, as their use entails heavy expense and much inconvenience. The arrival of a doomed ship is timed to coincide with a high tide, on the crest of which she is floated as far in as possible, to be left stranded well up the beach as the waters recede. She is then invaded by an army of wreckers, who strip the decks clear of all obstructions. Masts, funnels, bridges, deckhouse, superstructure, and gun turrets are the first to go, and in a surprisingly brief space of time there remains only the bare hull. Years ago it was customary to use explosives for breaking up the decks and wrenching apart the stout scantlings, but this method is no longer in favor. Dynamite has been superseded by the all-conquering oxy-acetylene torch, which cuts through stout plating like a knife through cheese. Gangs of torch operators swarm over the hull, cutting it down deck by deck until they reach the boilers and machinery. In small vessels these are lifted out intact; in the larger types the engines have to be broken or taken apart in the ship before they can be lifted out. When the hull has been razed as far as the double bottom, it is hauled up on to a framework known as a "grid," in which position the keel plating can be attacked and the job finally completed.

When a ship is fitted with side armor the plates are unbolted and lifted out bodily, to be dealt with on the wharf or in the wrecking shed nearby. Ordinary deck and shell plating is burned out in sections just small enough to be handled by the crane. These are then deposited on the wharf, to be cut up into portable sizes by the torch or mechanical shears. In some Continental shipbreaking yards the entire hull of the ship is cut up into small sections in the first instance, so that the junk can be loaded direct from the ship into railroad trucks or barges, as the case may be, for conveyance to the furnaces. This method is probably more economical in the long run than removing large sections which have to be cut up a second time before they can be transported in pieces small enough to pass through the furnace door, but, of course, it lengthens the wrecking process very considerably. Massive machinery and heavy castings removed from the ship are broken up ashore by the so-called "putt" or "skull-cracker." This is a primitive but effective device, consisting of an iron ball, weighing anything up to two tons, which is hoisted aloft by the crane to a height of 60 or 70 feet, and then released by a trip catch. Crashing down with tremendous force, it splinters the hardest metal like glass, and a few blows of this Cyclopean hammer will pulverize the stoutest casting. Few can watch the skull-cracker doing its worst on a magnificent set of marine engines, which but a few years since represented the highest example of engineering art, without meditating on the impermanence of human achievement; but it is consoling to reflect that all this fine material is not to be wasted. Smelted down and cast into new shapes it may serve some purpose even more immediately useful to mankind.

Through the combined efforts of the skull-cracker, the oxygen torch, and the shearing machine practically the whole of the material from a demolished ship is speedily reduced to mountains of scrap metal. To the uninitiated it may seem

Shell of the 2700-ton, 25-knot cruiser "Adventure." Beyond is the big ex-German flotilla leader, "Kaemperfelt," ready to be broken up

wanton extravagance to break up the boilers and machinery of a battleship, a cruiser, or a destroyer instead of converting it to some other use; but the truth is, of course, that naval propelling plant differs radically from that of merchant ships. Designed for high pressures and a correspondingly heavy fuel consumption, it would have to undergo considerable modification before it could be operated on an economical basis, and the cost of such alterations would be prohibitive. Thus a discarded set of man-of-war's engines is a white elephant, valueless except as junk. On the other hand, many articles of ship's gear and parts of the auxiliary machinery are taken out, furbished up, and sold as they stand. These include dynamos and motors, pumps of every description, boiler fittings, auxiliary steam, oil, and hydraulic engines, winches, ash hoists, condensers, distilling apparatus, refrigerators, tanks, ventilators, and a hundred and one items of marine equipment. Furniture and panelling, especially that from the officers' cabins and wardrooms, is also carefully removed and kept for sale. Pipes and cables are either sold as they are or reduced to junk. Previous to the introduction of the oxygen torch the destruction of big guns and armor plate was a tedious business, but now it presents no difficulty. Light and medium armor plate, *i. e.*, less than nine inches thick, can be cut up by a torch operator working on one surface only, but thicker plates have to be cut from both sides as the flame of the torch generally used in shipbreaking work will not penetrate deeper than nine inches. Guns of the heaviest caliber are easily cut up into sections. In pre-war times, when obsolete war craft were put up for sale only at infrequent intervals, shipbreaking was a less specialized trade than it has since become. With so much work in hand the firms concerned have found it expedient to employ new labor-saving devices, upon which, be it added, their workmen do not always look with favor.

A few words may be said about the purely commercial side of the undertaking. The service displacement of a warship must not be assumed as representing the weight of junk she will yield when broken up. When the naval authorities have taken out the guns, stores, ammunition, fuel, etc., the displacement is reduced by at least 25 per cent, so that a vessel nominally of 16,000 tons would be brought down to 12,000 tons before being handed over for demolition. Of this weight, steel would account for about 70 per cent, brass, copper, lead, and other metals for 15 to 20 per cent, leaving a 10 or 15 per cent residue of unmarketable waste. The value of metal junk is governed chiefly by the distance it has to be conveyed to the furnaces. Obviously it would not pay to break up a ship at some remote point on the coast, hundreds of miles removed from a smelting works, as the freight charges on the junk would absorb all the profits. In this respect British shipbuilders are fortunately situated, their yards being within easy distance of the great steel and iron manufacturing centers. There is, for example, a big yard at Briton Ferry, South Wales, and close at hand are some of the largest steel works in the country. Here, therefore, the cost of transport is a more or less negligible factor. It will be seen from the map that all the shipbreaking ports are conveniently near to important manufacturing districts. But, as before mentioned, business in the iron and steel trades is exceedingly slack just now, and for the time being shipbreaking has ceased to be a particularly lucrative proposition in Great Britain, even for those firms whose experience enables them to conduct it on the most economical lines.

Map showing location on coast of ship-breaking yards and their distances from the various steel and iron districts of England

Salvarsan and Neosalvarsan

IT is well known that arsenic is a very deadly poison. Less generally known is the fact that it can be taken in certain quantities without any bad effects at all, and if these quantities are increased slowly, finally a dose of arsenic, sufficient to kill the ordinary individual, can be safely administered. In certain sections, mountaineers are accustomed to take arsenic regularly in large doses, for it enables them to climb steep hills rapidly without loss of breath. The unfortunate part about this practice is that, like the use of narcotic drugs, once it is started, it is very difficult to get rid of the habit. But arsenic besides being a poison is also a drug, for it has very destructive action on certain disease germs. This fact was known to the Chinese ages ago and is mentioned in the writings of Pliny. The difficulty with the use of arsenic was the very fact of its great toxicity; and until the beginning of the study of physiological chemistry and the application of chemistry to the cure of disease, the drug was used but very little. What had to be done was to combine arsenic in such a manner with other elements that while the effect of the drug on the human organism was reduced to the lowest possible limit, the toxic action of the drug on disease germs was still strong enough to destroy them effectively. It was seen early that the thing to do was to combine the metal with organic compounds, and Ehrlich, who is renowned as the discoverer of 606 (salvarsan) and 914 (neosalvarsan), worked along these lines until he had obtained the proper combination to give the wished-for results.

These products are very complicated organic compounds containing arsenic, and belong to the same class of substances as the azo dyes. The method of manufacture is very complex and difficult. Originally they were made only in Germany, but ever since the German supply was cut off, a few years ago, they have been manufactured successfully in this country as well as in England and France. A very good description of the standard way of manufacturing both salvarsan and neosalvarsan is given in the French journal *Chimie et Industrie*, 1921, 296.

The hull plating is cut away by torch in large sections, which are afterwards cut up to furnace size by shears. This crane is lifting ashore a section of the British destroyer "Ribble"

Theoretically salvarsan can be made from seven different raw materials, but the process which has received the most extensive commercial application starts with aniline. The process is essentially one of synthesis, building up a complex substance from a very simple beginning. As aliline is made from benzol, which is one of the simple substances derived from the distillation of coal tar, salvarsan is what is generally known as a coal tar drug.

In the manufacturing process, there is produced an intermediate substance known as atoxyl. This product is of interest in that it was used with success in counteracting the germ causing sleeping sickness. Originally, an arsenic compound was used for this purpose, which was known as an arsenilide, and very often, when this drug was administered, it not only killed the disease germ but the patient as well. Atoxyl was found to be just as effective in destroying the germ as the arsenilide, but its toxicity was only one-fortieth of that of the latter.

To obtain 606, atoxyl is treated further. The process in this stage becomes exceedingly difficult to carry out and only the very greatest care will yield the proper quality of salvarsan. The principal thing that must be avoided is the oxidation of the product, as then there is produced a substance which is extremely poisonous and the drug must not contain more than a few hundredths of a percent of this product. Salvarsan is a yellow crystalline powder, and, due to its property of oxidizing in the air and forming the above-mentioned toxic derivative, it has to be packed with very great care, and the package in which it comes must not be opened except at the moment of use. The powder is placed in glass ampules or vials from which the air is carefully exhausted. Then the vials are sealed by melting the glass, and the tubes are examined by placing them in water. If there is any pinhole opening in the seal, water will be sucked into the vial. Every vial must be perfect.

The uses of salvarsan are in the treatment of certain microbic diseases, such as recurrent fever, syphilis, sleeping sickness. Recently, it has been used in the treatment of tuberculosis. The method of administering is by intramuscular injections, which are very painful. The solution of salvarsan is made in distilled water, which must be freshly prepared. The average dose is about 0.3 of a gram in 100 cubic centimeters of water.

In the early use of salvarsan, there were reported many cases of poisoning of the patients, due to the fact that in spite of all the care that was taken in its manufacture, the drug oxidized and formed the extremely toxic arsenious products. To avoid such happenings experiments were undertaken to see whether it was possible to produce a substance which would not have this dangerous property. The result was neosalvarsan or 914. This is made from salvarsan. The product is bright yellow and contains about 20 per cent of arsenic. It is packed in the same way as salvarsan, but it will not oxidize and can be administered without endangering the life of the patient. In addition to these products there is another preparation known as 1495, which resembles salvarsan very much and which is used to some extent. It is claimed that the injection of this drug does not give the intense pain caused by salvarsan or neosalvarsan injections. Some idea of the industry necessary for investigations of this character may be gleaned from the fact that the numbers attached to the three marketable commodities obtained represent their positions in the series of compounds with which Ehrlich has experimented, and presumably with which he is still experimenting, in his search for the perfect arsenic drug.

Sensitizing Solutions

THE dyes which are used in color sensitizing ordinary (blue sensitive) plates by bathing, require different methods for their most successful application. Pinaverdol, pinachrome, orthochrome T and homocol may be used in water solutions, with or without ammonia, and are very little sensitive to electrolytes. Pinacyanol may be used in a water solution provided the plates are first thoroughly washed, but gives greater sensitizing action with more fog and poorer keeping quality when used with water, alcohol and ammonia. Dicyanin gives comparatively little sensitizing except when used with water and alcohol and a fairly large per cent of ammonia. Commercial panchromatic plates have their color sensitiveness increased by washing in water, without having the increase in fog which occurs when they are treated with ammonia. Scientific Papers of the Bureau of Standards, No. 422, entitled, "Color Sensitive Photographic Plates and Methods of Sensitizing by Bathing" covers this ground and is now ready for distribution. Anyone interested may obtain a copy by addressing a request to the Bureau until the free stock is exhausted.

Left: Willow mat awaiting the placing of rock to sink it. *Right:* Putting down the pine cradle to prevent erosion of soil

How rock and timber were combined with sand to build a road through the bed of a lake

Building a Road With a Dredge

Sand, Pumped from the Mississippi River, Carries the Highway Across a Wisconsin Lake

By L. J. Jellison

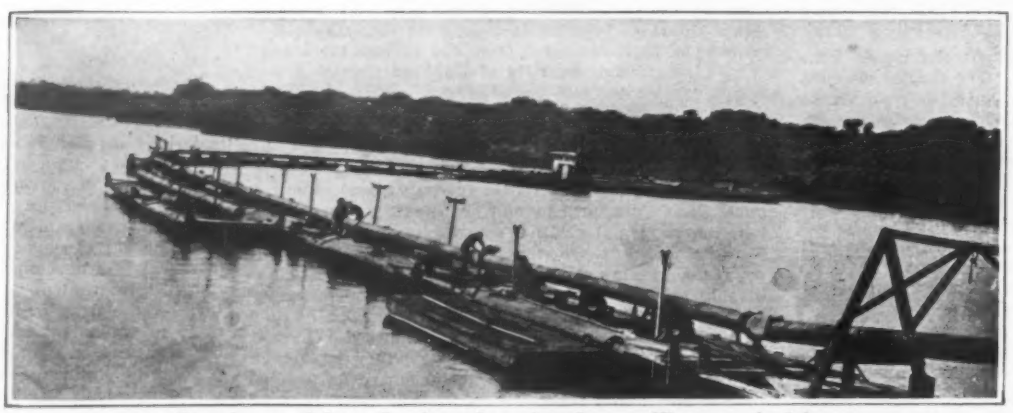
A UNIQUE feat—that of constructing a sand road through a lake—has been completed by Wisconsin State Highway engineers at Sunfish Lake, through Grant county in Wisconsin. The lake road, 32 feet above high-water stage, to prevent spring Mississippi river floods from interfering with traffic between Iowa and Wisconsin, was built on a relocation to obviate two bad curves that have taken toll of many lives. The road is a mile and a quarter in length.

The principal feature of the construction is the fact that over 100,000 cubic yards of sand were necessary to fill the lake and give a 30-foot wide road, with 150-foot base. Rock was secured from a quarry at the end of the fill, while willows used to riprap the sides were secured from an area of half a mile from the work.

Water, sand, willow and rock entered into the construction of the spillway as the road is called. A broad expanse of bottom land with a 50-acre lake confronted engineers when they arrived on the scene. Dredges anchored in the river sloughs off the main channel of the Mississippi river, began pumping as soon as the road location through the lake was determined upon.

Eight weeks of pumping continuously through 24 hour shifts was necessary for the sand fill. Working from the river, lengths of pipe were added from time to time to the discharge lines as the level of the sand being pumped from the river sloughs reached the height desired, until, stretching away in the distance, a sea of sand, the lake road was completed.

Unless means were taken to check erosion, the sand road as pumped from the dredges would be swept away during the first Mississippi river flood, when the stage reaches 21 feet from a normal 6-foot level. Rock and willow entered as factors in the making of the road. Save where certain portions are to bear the brunt of high water, only willows are used to check washes in the sand, due to rains and high water. Where water pounding is anticipated, or current swings, riprapping, using willows covered with rock, is employed to protect the roadway from the water's action.



Pumping sand from the river channel to form a fill across the lake

Mats are made. Several dozen willows are bound together and other similar bunches connected until a broad blanket of willow bound together is secured. These are placed at the water's edge and for a distance of approximately 24 feet toward the peak of the fill and beyond the estimated water stage reached.

Where there is an undertow and in order to prevent a cave-in the procedure to protect that portion of the work is slightly different. A broad mat of one-inch boards is made. It is floated to the edge of the fill and anchored. Willow bunches similar in size to mats made are affixed with thickness varying according to the character of the work to the mat. A covering of rock sufficient to sink the mat and hold it is placed.

Where wind currents are expected to lash high seas willow mats in place are covered with a coating of rock. The majority of these rocks weigh 10 pounds or more. Willows in mats are always placed with the thicker end facing into the current. The back wash binds sediment into the tops and brush of the lighter ends and furnishes in time a solid wall of mud and sediment making the riprapping indestructible.

The road at the point where the sand fill was made consists of a sand core with blanketed sides of willow and rock depending on the amount of water wash. For surfacing the sand core, a preliminary coat of earth mixed with rock is used. Gravel and asphalt, or cement, depending on surfacing plans, is used for a finishing coat. Roads of this character are usually equipped with guard rails, cedar posts imbedded along the edge of the fill, and showing the danger line beyond which it is unsafe for vehicles to venture.

The completed fill, ready for rock and willow riprapping

The Light of the Night Sky

PROF. CHARLES FABRY, in a recent issue of *Scientia*, discusses the luminosity of the night sky. He asks whether or not this luminosity can be attributed to an unresolved background of faint stars. In this connection he insists on the importance of concentrating attention on some small selected area and determining how many stars of each magnitude are present, with a view of extrapolation to stars below the 20th magnitude, which cannot be detected by existing telescopes. The luminosity of the general background of this area should be observed concurrently. If, as appears probable, we cannot plausibly attribute the general illumination to unresolved stars, it would be natural to fall back on the hypothesis of scattered light. That the light can be due to scattering by gaseous matter appears improbable in view of Lord Rayleigh's recent observations on the color and state of polarization of the light of the night sky. The article concludes by reference to the aurora as contributing in some cases to the light of the night sky.

Why Did the Hermit-Crab Become a Hermit?

A Chapter from the Story of the Struggle for Existence That Accounts for This Curious Creature

By William Crowder

Male and female hermit-crabs. The little female, perched on the shell of the larger male, is his constant companion during the mating season

TO know the hermit crabs is to know the really engaging animals of our shores. Their comical antics, their brawls and everlasting search for trouble, would mark them at once as creatures of no mean individuality. And how carefree an existence they lead! It is true they have some enemies which occasionally disturb the happy tenor of their lives; but for the most part their time is given over to a riotous round of pleasure—and pleasure to a hermit crab means feasting, lovemaking, and above all, fighting.

Yet they are deserving of sympathy. They have other distinctions besides the foregoing which claim our consideration. For in the story of their lives is entailed one of the most extraordinary revelations to be found in nature. The tragic details will never fully be known, but from the few fragments that are now decipherable there is indicated a history of an ancient struggle for existence, than which that of the rise and fall of an empire is not more impressive.

I will incidentally observe in passing that the present writing owes its inspiration to *Pagurus longicarpus*. What is true of the little hermit of our own coasts may, in a larger sense, be taken as typical of the entire group.

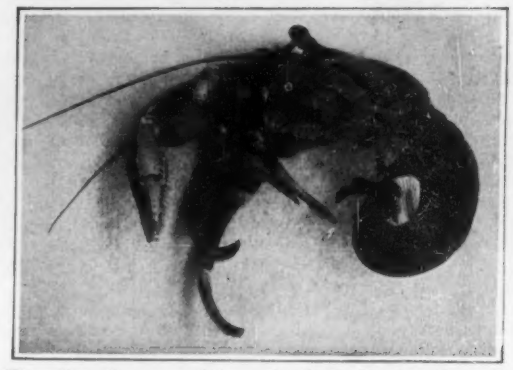
The most outstanding feature of the hermit crabs is undoubtedly their curious habit of living in the shells of dead mollusks. This habit has been confirmed for a very good reason. If we remove from its shell a full grown individual—the male, by the way, is larger than the female, and is about two inches long and of the thickness of a lead pencil—we find that, unlike the foreparts, which are armed with a thick, horny crust, the abdomen is very soft and invested with a delicate membrane. The slightest rupture or abrasion to this abdominal covering is almost certain to be fatal.

This region is unsegmented, differing from the ringed belly of the lobster and other higher crustacea, and tapers spirally toward the tail, which latter is an aborted caudal fan. It is here that the digestive tract ends. Two other appendages are on the left side; a glance at their location and malformed appearance leaves no doubt as to their origin. They are the vestiges of what, in the ancestral form of the animal, were once highly specialized locomotor organs. These feeble bristle-fringed outgrowths, however, now serve an entirely different purpose than formerly; on the male their chief use is for sweeping forward the stercoracious matter deposited in the shell; on the female they have an additional function as anchorages for her eggs. Briefly, the belly functions mainly as an organ of prehension wherewith the animal maintains a hold on its portable home.

It is apparent that the hermit crab is obliged not only to utilize a defensive covering, but when exchanging shells it must act with the utmost caution and dispatch lest it be harmed by some enemy who may be lurking near. This exchange is often made at the mere whim of the animal, but there are several periods in its life when a new home becomes absolutely necessary. This is after each molt, the consequent increase in size forcing him into larger quarters.

The hermit crabs are notorious fighters. Yet in the hundred encounters I have witnessed between them, in not one have I ever seen a serious bodily injury resulting therefrom. But curiously enough, the inevitable result of every combat is the loss of a shell by one of the antagonists. I can not visualize this better for the reader than by abstracting from my notes my first observation of this interesting sight. Although this record was made some time ago, I could not add to it if I would. So I transcribe it here without change, just as it was written at that beautiful tide-pool not far removed from the present writing in Glen Cove. I had just been watching a large male busily devouring a portion of dead fish, which he ate by pulling off small pieces with his great claw and bringing them to his mouth. While he was thus engaged a strange hermit crab, evidently attracted by the feast, appeared on the scene. The newcomer, also a male, was of an unusual size; his shell was covered with a downy growth—a colony of zoophytes—which made him look like a giant clad in furs. Then:

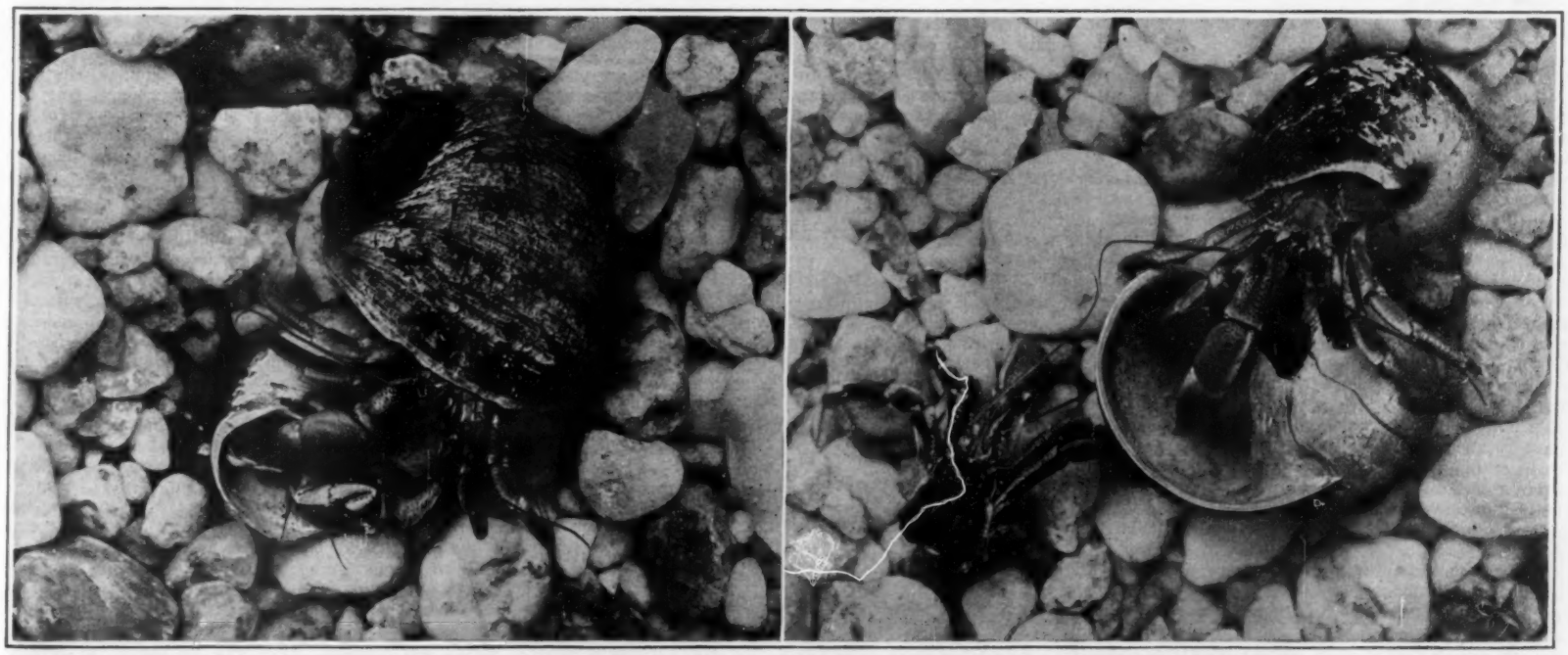
"Each catches sight of the other at the same instant. A momentary pause ensues. Then with their great claws extended each rushes for the other furiously.



Hermit-crab removed from its shell, showing the soft and vulnerable hind-body which requires a borrowed armor for its protection

The clash and rattle of their shells can be heard distinctly through the shallow waters as they come to a close, wildly seeking an advantageous hold. Jabbing, cuffing, wrestling, they display an astonishing agility, encumbered as they are with their heavy shells; the rapidity of their movements seems almost incredible. One is now uppermost; now the other. Suddenly they part and encircle one another with a sidewise movement. Again they come together. But something happens. . . . The newcomer, betraying a craven spirit, wrests himself away and precipitately leaves the field by a backward run. His retreat, however, is obstructed by a small rock, and the impact sends him topsy furvy, causing him quickly to withdraw completely into his shell and block the opening with his claws. In a trice the other is upon him. Seizing one of the exposed hands he attempts to dislodge the coward by tugging so violently that the collision of their shells beats a tattoo. The persistent attack apparently arouses a spark of resentment in the larger, for he emerges sufficiently to flourish a threatening pincer. This is his undoing. He is immediately grasped by a leg, jerked clear of his shell, and tossed over the victor's shoulder. The latter, then grasping the rim of the empty shell, vaults over into it and leisurely crawls away. . . ."

The number of eggs in the spawning of a female hermit crab rarely exceeds 300—indeed, the number is often far less. They are deep cherry-red and no larger than the period which ends this sentence. Each one is suspended in a membraneous sack which in turn is attached by a short thread-like tissue to a bristle on one of the forementioned appendages. They are car-



Left: **Male hermit-crabs fighting; the aggressor is attempting to drive the other from his shell.** ***Right:*** **The victor moves into the shell from which he has driven the other crab; the defeated hermit hovers just out of reach of his conqueror's claws, waiting an opportunity to seek his own safety in the abandoned shell of the other**

A battle of hermit-crabs, and the curious outcome

ried thus by the mother—who gives them no other attention than an occasional brushing to keep them free from particles of dirt—for a fortnight, when they are ready to hatch.

In the meantime, however, some remarkable changes have been taking place. If under the dissecting microscope we tear open an egg which is but a day old the differentiation of its organization can be seen making its first appearance. That mysterious transformation, due to those unfathomed forces which cause the cells to assume their predetermined arrangement, has just taken place. Nearly a week later examination of one of the spherical units will show that the yolk comprises nearly half the bulk, while the remainder of the egg content reveals the dim outlines of the nascent larva. Each succeeding day the embryo is marked by a gradual but very definite change. Finally the tiny animal acquires a segmented hindbody, a large tail fin, and a pair of unstalked eyes. A more dissimilar offspring from the crawling adult could hardly be imagined; for the muscular ringed belly and broad tail singularly adapt it at this stage to a roving life at any depth.

The moment for hatching is always signalized some hours before by a restless activity on the part of the larvae, and by their apparent efforts to burst the double envelopes which confine them. Suddenly the walls of an egg will split lengthwise and a wriggling youngster emerges through the rent. It has no time to linger, as it is caught in the respiratory currents of the mother and sent hustling away. A common impulse then seems to animate the brood, and within a few hours the remainder of the children abandon forever the precincts of the maternal shell. The mother then detaches the swaddling clothes still adhering to her appendages, and soon following the departure of her young she sends bag and baggage flying after.

Thenceforth each little hermit crab pursues its uncertain fortunes alone. After a lapse of nearly two months—during which it molts not less than four times, each time increasing in size and acquiring a more adult-like form—it settles to the bottom and finds a tiny shell.

Such is the manner in which the hermit crab is ushered into the world. A rapid survey of its future shows that before the winter gales have forced it into the deeper waters to pass a semi-dormant existence it has molted once more and has now attained the length of a quarter of an inch. The following summer will find it considerably larger, provided it will have had plenty of food, and by the end of the third year it will have arrived at sexual maturity; whereupon it will begin to take notice of its fellows, both male and female. From this time onward its brawlings and lovemakings will continue until the end of five years, when, realizing that the business of life is done, it crawls under some sheltering frond of seaweed and dies.

Now, if one accepts the evolutionists' theory that the embryological forms of an animal tend to recapitulate the evolution of the species, there is more, then, than a mere hint in the foregoing that the hermit crab did not always require a shell for its protection. As the fossil remains of crustaceans have been so meager, there is now, of course, no certain means of determining the true appearance of the hermit crab's ancestor. Nevertheless, some reliance may be placed in the data afforded by comparative anatomy when attempting to reconstruct the phylogeny of a species, and from these data it may reasonably be assumed that the ancient forbears of the hermit crab possessed a segmented abdomen equipped with specialized appendages for swimming. From this it follows as a corollary that it was a rover of the open sea. That it later frequented the floor of the ocean is very probable. The present habits of other higher crustaceans—such as the lobster and kindred types—point unerringly to this conclusion.

But why did the primitive non-shell-bearing hermit crab forsake the open reaches to become a dweller of the shore waters? The answer to this question admits only two possible inferences. It was forced to seek this habitat for reasons either of hunger or of safety. I think the first mentioned may safely be dismissed as wanting in plausibility. There is no good reason to believe that food material suitable for these animals did not always thrive in as great abundance in the outer regions as well as contiguous to the shores. In regard to the remaining factor, I will say at once that this latter seems to be the true and only cause. It was because of the appearance on the scene of a new and powerful enemy. This enemy was the first vertebrate—the mailed fish. For it must be remembered that until that time the crustaceans alone held dominion over the floor of the sea, and the greatest enemy of the crustaceans were themselves—the larger preying upon the smaller. But with the advent of these new marine terrors came a change. The extinction of the hermit crab was threatened. In fact, the actual disappearance of hundreds of groups, now long lost, was caused by their ruthless appetites.

The case then clears itself. With the ever constant menace hovering over it for generations after generations, the hermit crab was driven to the shallower waters and into any place which afforded a shelter. In the great abundance of shells in this neighborhood it found an admirable haven of refuge. Later it found it quite convenient to carry the shell with it, instead of venturing forth unprotected in search of food. And it was not until the disappearance of these monstrous enemies that certain of its shell-bearing kin wandered back into the deeper waters.

But this change to a fugitive life also brought a change in its diet, and ages of an abnormal adaptation have changed the structure and functions of its body. From the predatory life of a rover and a freebooter it has descended to the life of a scavenger. His belly, once an entity of strength, is now a feeble mass of pulp. In a word, the hermit crab is a degenerate.

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Left: The finished box being taken out of the press. *Center:* All manner of fancy designs can be achieved in these boxes. *Right:* A row of finished boxes being sprayed

Making boxes from a chemical composition obtained from ashes and sawdust

Ashes and Sawdust the Basis of a New Industry

By C. M. Lewis

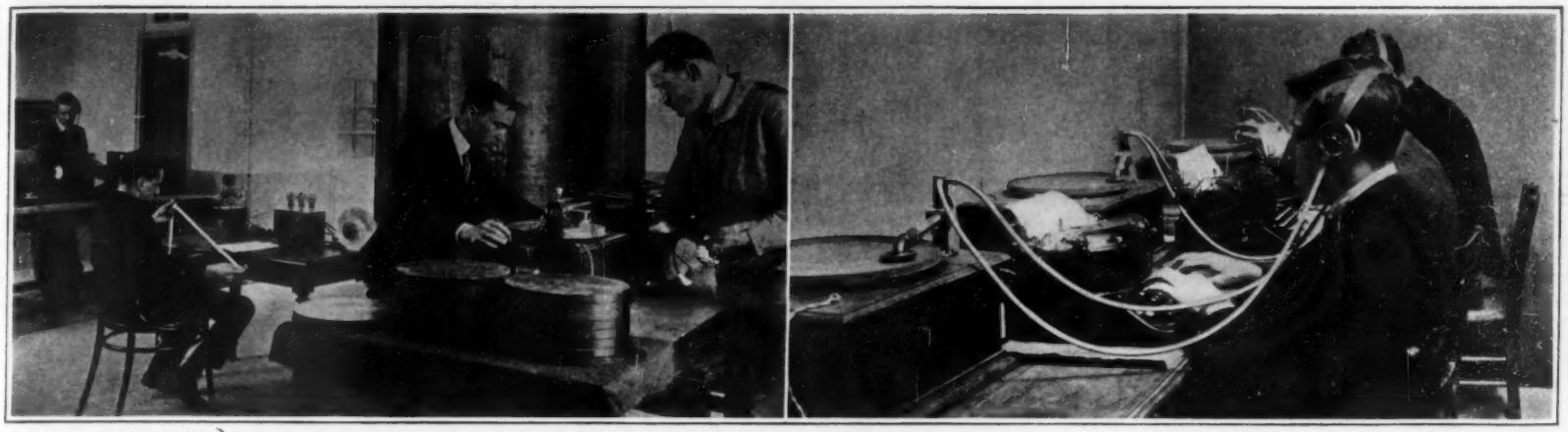
IN these days of large-scale production and large-scale waste in American industries, it has remained for Dr. Christian Jaeger to utilize two of our most easily obtained waste materials, sawdust and ashes, in a remarkable chemical composition which is a substitute for cardboard and wood. After long and patient study and experiment, covering a period of ten years, he has at last discovered a process which has opened up a new industry. When we consider that there are approximately ten thousand wood and cardboard box manufacturers in the United States, and that the annual output of the box trade runs into the millions, we must realize how important is this new composition, which is used largely in the production of boxes.

It is an interesting experience to watch the production of these boxes, really beautiful in design and finish, from the mixing room to the painting room, when the finishing touches are applied by skilled hands. Of course, the mixing room holds the secrets of the process. We know that ashes and sawdust—the ashes of any substance and the sawdust from any wood—are the two main ingredients of the composition. To these two constituents chemicals are added; the whole mixture is worked together thoroughly and rubbed by hand through a large sieve; and the resulting rather coarse, dry powder is then ready for the presses.

The operation of the presses is an important factor in the cheapness of the whole process. There are four presses in Dr. Jaeger's factory. Two of them are for the making of the bottom parts of the boxes; and two of them, by means of elaborately designed bronze dies, impress upon the covers of the boxes designs ancient or modern, Roman, Greek, Egyptian, Gothic, Moresque, or of the Renaissance period. The powder from the mixing room is inserted in little boxes under the presses; the presses are lowered for a period of about three minutes; the powder bakes like bread, turns a delectable, creamy brown, gives off a pungent odor; the presses are lifted; and out come the boxes, complete in shape and design from a single operation. One of our photographs shows a close-up of a tray of boxes fresh from the presses. The rough edges are smoothed off on rotary emery wheels; then the boxes go to the painting room.

The discovery of a paint which could be applied to this composition was not made until after a good many fruitless experiments on the part of Dr. Jaeger. At first, the paint refused to stick to the surface; it curled up and flaked off. At last, after about two years, Dr. Jaeger produced a paint that could be applied smoothly and would give an even, glossy finish. The first coat of paint is applied by hand. One of the virtues of Dr. Jaeger's paint is its drying quality. No drying rooms are necessary; almost as soon as the first coat is applied the boxes are passed on to the workmen who handle the air brushes and finish them with delicate tints or with ivory, ebony, bronze, silver or gold effects.

The finished boxes are light in weight, washable sanitary and non-poisonous. They are as fire-proof as asbestos, waterproof, and can be made of any degree of texture or flexibility, either as pliable as cardboard, as hard as oak, or as tough as metal. They are very cheap; a pound of the substance, from which about three boxes can be made, costs not more than five cents. Climatic changes will not affect them; they neither shrink nor expand. They can be plated in genuine bronze, silver or gold, or finished in the process with a surface of chemically prepared silk or satin, real or imitation plush or velvet.



Left: General view of the recording room in a French high-power radio station. In the foreground the operators are engaged in recording an incoming message by means of a disk phonograph. Behind these operators may be seen a special wire cage, which contains the receiving equipment and protects it against local parasitic disturbances. To the left may be seen two operators adjusting the photographic recorder and reading the photographic record tape. *Right:* Three operators transcribing the dots and dashes from the phonograph records. Each operator attends to one phonograph, and uses a noiseless typewriter

Capturing the elusive dots and dashes of radio on phonograph records and photograpic tape for subsequent transcription

Speeding Up Radio

New Methods Employed for the Automatic Reception of Radio Telegraph Dots and Dashes

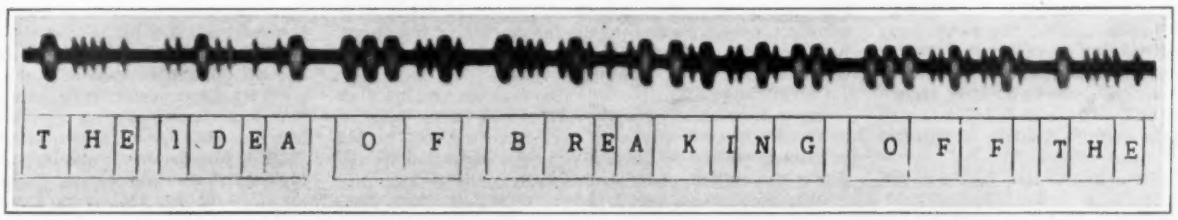
By Francis P. Mann

THE capacity of radio telegraph stations is to be increased to a considerable extent in the near future by the use of rapid methods for receiving the messages. The efforts in this direction which have been made by one of the largest French radio companies are now meeting with great success. This firm has been very active in the construction of wireless stations, one of the most recent being the great station of La Doua, at Lyons, which is now working with the United States. This station has already been described in our columns, so that we will confine our present efforts to a brief account of the methods and apparatus which are employed for recording the messages at high speeds.

The phonograph method is employed for taking down messages at speeds which are considerably above the usual rates, this speed being in all cases above 25 words per minute and may reach as high as 100 to 150 words. But it is evident that messages with the dot and dash system cannot be read at such high speeds on the telephone by the operators of the station. The phonograph can, however, be called upon to take down the messages at these rates, and by means of the new apparatus the signals are now recorded upon the phonograph without difficulty. A phonograph of the customary disk type is employed for this purpose, making necessary certain slight changes in the equipment, such as are required to adapt it to radio service, all that is necessary being to mount the receiving telephone in the place of the usual phonograph recording diaphragm, the telephone diaphragm being provided with a stylus for producing the record on the disk.

It is found that the phonograph record is still quite satisfactory when the apparatus is working at 150 words per minute. When the disk has received the telegraph message, it is transferred to a second device which serves to reproduce the sounds in the usual manner, but the record type of phonograph is of a somewhat different design, and is designed to operate at slower speed in order to enable the operator to read the messages.

One of our illustrations shows in the foreground the high-speed phonographs which are employed to take down the messages, while in another view will be observed the slow-speed apparatus used for reproducing purposes only, with an operator for each phonograph taking down the messages on a noiseless typewriter as fast as he is able to write. In order that the sound shall not be of too low a pitch when running the phonograph at reduced speed for receiving the messages, the radio receiving apparatus is regulated, in case the system of continuous waves is employed, in such manner as to provide a high pitch for the original message, so that the pitch can afterwards be reduced without being too slow to carry out the receiving operations to good advantage.



Piece of photographic recorder tape containing part of a message received at the rate of 200 words per minute, with the transcribed message below each dot-dash character

A still higher speed for recording wireless messages can be reached by making use of the photographic method, and by the use of improved apparatus recently brought out by the French firm it is possible to operate at speeds which can handle up to 500 words per minute. This makes it a more rapid means for receiving messages than the phonograph system, and the new photographic apparatus is not of an unduly complicated nature. Indeed, it is so designed that all the operations can be carried out in a very simple manner and by persons having no very special skill.

The photographic recorder is based on the use of a galvanometer containing a small mirror which is adapted to swing under the action of the radio impulses forming the signals, the current at the receiving end being amplified to the proper degree by the use of the usual amplifying devices. The duration and amount of the swing of the mirror will correspond to the dot and dash signals, while the mirror reflects a beam of light on to a strip of sensitive paper tape which is caused to unroll at a greater or less speed, according to circumstances. The beam of light thus traces the message on the strip. The result is that the message will appear in the form of dots and dashes, as shown in one of our illustrations, when the strip is developed by the usual photographic process. No difficulty is experienced in taking down messages at the rate of 500 words per minute. It should be remarked that such messages could not be read by a station which is not provided with the photographic receiving devices.

The new system will be valuable as affording a method of considerably increasing the capacity of radio stations, and the method is, in fact, comparable to automatic telegraphy. The developing, fixing, washing and drying of the photographic strip are carried out automatically by means of an improved device which performs all these operations within a very short time. It is now found possible to use the same photographic strip to receive messages sent out by two different stations at the same time, or by the same station sending two simultaneous messages (in fact, several messages can be sent) on the new multiplex system. In the present devices, two messages can be taken down at the same time and upon the same photographic strip. When the latter is completely finished, it can be read in the same way as an ordinary telegraph recorder tape.

The dot and dash signals are very sharp and clear, allowing the messages to be rapidly read off. It should be remarked that the dots and dashes being received can even be heard in the telephone receivers, even though they are too rapid to be read, but this at least affords a good means for adjusting the recording apparatus. The new devices have all the sensitiveness of laboratory instruments and at the same time are very simple and strong, being adapted for actual use in radio stations.

The photographic recording apparatus will be observed in the background of one of our illustrations, which shows the various devices in a French radio station.

Photographic recorder working at a speed of 200 words per minute. The operator, wearing the 'phones, hears the signals and can adjust the recorder accordingly

Lumber from Sugar-Cane Waste

Bagasse the Raw Material for a Product Designed Largely to Replace Wood and Relieve Our Forests

By Charles R. Ferrall

FOR twenty-five years many scientists have been working on the problem of finding some practical usage for bagasse, the cane fiber as it comes from the sugar mills after the juice has been extracted. It is produced in enormous quantities in the sugar-making sections. Professor C. E. Monroe, inventor of smokeless powder, Washington, D. C., has finally discovered a practical use for this material after spending a considerable period of time in experimentation.

Dr. Monroe's invention contemplates the use of this formerly waste material in the manufacture of a building board. When the question of the location of a manufacturing plant was given consideration it became obvious that New Orleans was the logical place. It is estimated that there is enough sugar cane fiber available within a radius of fifty or sixty miles of the plant to make 200,000,000 square feet of new product annually. The new plant is 1,000 feet long by 125 feet wide comprising a manufacturing building, power plant, engine room, boiler house, a dryer building over 800 feet long, and a finishing building with necessary equipment such as storage and water tanks. From time to time additional units will be added as needed.

Some of the machinery in use in the new mill had to be invented especially for the particular purpose for which it is used in producing the product, as there was no machinery that could be used for the purpose in existence. The plant began operation in a small way in August, 1921. Small quantities of "celotex" were produced during the first days of operation in order to perfect the manufacture, to get the board uniform in thickness and of proper texture. However, the experimental stage is past and the board which is being turned out at the present time is of high grade and uniform quality.

The sugar cane fiber comes to the mill in 200-pound bales. These bales are opened and started through the process of manufacturing, eventually coming out in the form of a great board of insulating lumber. This board, after it is properly cured, is sawed into proper dimensions by automatic saws. The product is waterproofed and boxes made of it have been known to contain water for a great many days without leaking.

When the raw material is unloaded from the cars and started on its journey through the factory it is not touched by hand until it is delivered to the finishing room ready to be bundled and shipped. Sugar cane is practically the sole material used, the other materials required being merely the chemicals used in the mill process. In the process of manufacture the cane fiber is carried successively through breakers, soaking tanks, steam cookers, which thoroughly sterilize it, washers and on to the manufacturing machinery through the dryers and into the cutting-up saws by automatic machinery and devices.

Celotex is made in thicknesses of one-half inch and one-quarter inch, and is cut into boards four feet wide by eight to twelve feet in length. The board is homogeneous—that is, it is not built up in layers but the cane fibers are so interlaced that they form a uniform stock throughout. It is unique in this respect. Other building boards are built up of layers of paper cemented or glued together. The new product gets its perfect insulating qualities from the fact that it is filled with minute air cells formed by the interlacing of the fibers, together with the cells in the fiber and pith of the cane.

One of the peculiarities of bagasse or sugar cane fiber is its indestructible quality. It resists decay to such an extent that after lying in the fields for a long period of time it seems to be in as perfect condition as the day it was milled as far as any indications of decay are concerned. This is a very strong point in comparison with ordinary lumber.

Due to its high insulating qualities there is no doubt but that the new lumber will be largely used in the manufacture of refrigerators, fireless cookers and the walls of storage plants, and many other places where perfect insulation is required.

It is designed to take the place of lumber in every particular, such as for sheathing on the inside and outside of houses and paneling and for practically all other purposes for which lumber is used in building. It can be stuccoed and plaster will adhere perfectly to it. It is a good deadener in walls or under floors. It can be used under linoleum or oilcloth for flooring.

Celotex will stand the weather. In fact, it is expected that it will be used extensively for weatherboarding and outside finishing in a great many buildings. Practical uses are being found for it every day in industry and no doubt it will be extensively employed in manufacturing merchandise. Furniture manufacturers are already buying it in quantities to be used for veneer work, drawer bottoms and for many other uses in the furniture industry. Even boat builders and ironing board manufacturers are investigating its use and are experimenting with it at the present time.

It weighs but six-tenths of a pound per square foot in one-half inch thickness, which makes it much lighter than any wood lumber. It can be handled and sawed just like ordinary lumber. Its color is a pleasing shade of tan and the surface is rough like burlap, although it is contemplated to sand or plane one side of it so that it will have a perfectly smooth finish.

It has been shown as a result of tests, that building with this lumber will result in a saving of at least one-third of the fuel ordinarily used, due to its insulating qualities which prevent the passage of heat or cold.

The Comodoro Rivadavia Oil Fields

Argentina's Prospects of Entering the Group of Petroleum-Producing Nations

ARGENTINA, an agricultural and pastoral country par excellence, richly endowed by nature with an enormous wealth of raw materials capable of being manufactured into the finished goods demanded by its growing population, has been in the past and still remains, industrially speaking, little more than a vassal of the manufacturing nations of the world. Each passing year finds her busily engaged in tilling her soil and tending her herds in an effort to find the necessary funds for paying her annual tribute whose principal item is represented by the huge sums expended for fuel, both coal and oil.

Coal in commercial quantities, though probably existing within her vast territory, has not as yet been discovered and worked. Neither has the search for it ever been systematically and persistently made. The burning of valuable hardwoods in the furnaces of the Republic on the prodigious scale practiced up to date is suicidal. Therefore her visions of a gradual industrial emancipation in the near future depend upon the development of her latent oil resources. Without this her hopes are doomed; but given this development the preamble of her declaration of industrial independence will have been written.

The apathy regarding the Argentine oil fields at Comodoro Rivadavia which has existed since their discovery in 1907 up to the past two years is greatly to be lamented. In part this indifference may be ascribed to a lack of adequate mining laws; the scarcity of funds for development purposes, and the dearth of technical experience on the part of the Argentine people. But the want of real interest shown by the general public looms larger than any of these. The Argentine people, accustomed for generations to considering farming, livestock grazing, commerce, politics and the practice of the professions as their major occupations, were not quickly interested in the oil business. Moreover, capital, where lands, cattle, town and city property were not concerned, has been timid about investment in new enterprises. The wrecks of so many Argentine mining and industrial stock companies may be pointed out as the causes of this diffidence.

Happily a nationwide awakening to the possibilities for the development of a domestic fuel supply has taken place; hereafter each year ought to see more progress than was witnessed during the entire decade between 1907 and 1917, for, Argentina, in the opinion of oil experts, is on the eve of a remarkable expansion in oil production.

The discovery of oil in Comodoro Rivadavia did not come as a result of geological surveys which usually guide the drillers' efforts. To the lack of water in this village, founded in 1901 on the barren, wind-swept coast of the Territory of Chubut, Argentina is indebted for the discovery of what today constitutes its principal mineral wealth.

In 1903 the Department of Mines began drilling for water at this point with a rotary outfit. An accident occurring at a depth of 500 feet made it necessary to abandon the enterprize before finding water. It was only after four years had elapsed that the drilling of another well was undertaken.

In 1907 an outfit capable of sinking a well 1700 feet began to bore the well known as "Chubut No. 2," about one mile north of Comodoro Rivadavia. When a depth of 1600 feet had been reached on December 13, 1907, a stratum of oil-bearing sand was encountered. This unexpected discovery called forth the decree of December 14, 1907, whereby the Argentine Government reserved as a fiscal zone all territory comprised within a radius of four miles around the town of Comodoro Rivadavia.

During the next three years five wells were sunk, all of which encountered either petroleum or gas. During the same period many concessions were obtained by private companies outside of the zone reserved by the Government. However, one dry well of 2000 feet, sunk on the beach of Bahia Solana by the Gulf of San Jorge Petroleum Company, represents the entire efforts made by private capital during this period. In 1910 and 1911 Congress voted further funds for development, and made further reservations of land.

In 1913 it became evident that the economic handling of the oil produced made the construction of storage tanks and the purchase of tank steamers imperative. For this purpose a total of 15,000,000 pesos was voted. Since that time the Government oil works in Rivadavia have called for an annual outlay of 1,500,000 pesos in addition to the funds resulting from the sale of the entire production, which varies in accordance with current market prices and the amount of petroleum extracted.

Among the serious problems engineers in charge of these fields have been forced to solve is the question of water, which has to be transported in pipe lines from a considerable distance. Moreover, this water must be obtained from limited natural sources scattered at random in the vicinity of Comodoro Rivadavia. At the same time no port exists in the neighborhood of the field, and vessels have to lie at anchor when loading petroleum from the pipe lines. Due to the frequent storms to which tankers are exposed, a great deal of time is often lost in their loading and discharging.

Up to date approximately 140 wells have been sunk, the larger portion of which are located on the Government reserve. However, a number of private companies have producing wells on concessions immediately adjacent to the territory reserved by the Government. Storage tanks sufficient in capacity to handle a production considerably in excess of the oil actually extracted have been erected in Comodoro Rivadavia and additional tanks are being constructed in practically all of the larger cities of the Republic.

It may be stated without fear of contradiction that the oil fields of Comodoro Rivadavia have an assured future in supplying the domestic market with fuel. Their only rival, Mexico, with its enormous production of petroleum, is too far away to continue competing in the Argentine market once Argentina's oil is produced and marketed on a large scale. At present the Argentine Government, as well as private companies, are giving especial attention to the possibilities of refining crude petroleum. This will undoubtedly give a decided impulse to production.

Other known Argentine oil fields are faced with transportation problems which cannot be solved until such time as the demand for petroleum has reached a point where capitalists will feel justified in the construction of pipe lines or railways necessary for bringing the oil to consuming centers. In the meantime Comodoro Rivadavia, with cheap ocean transportation, will be called upon to supply the country with oil.

Evolution in Museum Technique

How the Lifelike Animal Groups of Today Are Executed

An Interview with Dr. F. A. Lucas of the American Museum of Natural History, by A. A. Hopkins

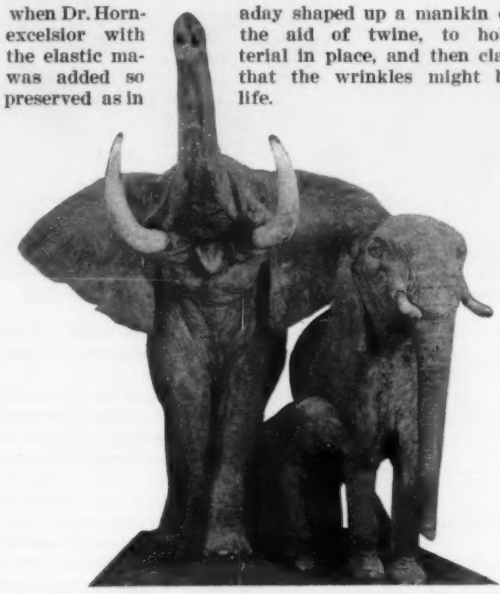
THERE have been changes, even fashions, in the form of presentation of groups for public observation in my time. Twenty-five years ago there was scarcely a group of animals worthy of the name, in the United States or in Europe, indeed, for that matter. Of course the idea had been crystallized in an early group of large African mammals in Bullock's Museum, in 1815, the panorama, then at its apogee, being employed with the accessories of plants, rocks, etc.; but the result was far from realistic, and the product was not very scientific or very accurate. Museums with rare exceptions were buried away, and in many cases the reluctant bolt was only drawn back after repeated pulls on the bell which echoed through the cold and cheerless halls. Material was mainly for the use of students who did not need to be entertained or specially educated. A white paper background was considered good museum practice, and as long as the specimens were in a condition to be studied and compared the ends of museum economy were satisfied.

I remember that in 1874 Dr. Coues, one of our first naturalists and writers on natural history, said: "Spread-eagle style of mounting, artificial rocks, flowers, etc., are entirely out of place in a collection of any scientific pretensions, or designed for popular instruction. Besides, they take up too much room. Artistic grouping of an extensive collection is usually out of the question; and when this is unattainable, halfway efforts in that direction should be abandoned in favor of severe simplicity. Birds look best, on the whole, in uniform rows, assorted according to size, as far as a natural classification allows."

I wonder what Dr. Coues would say now if he saw the beautiful collections of bird habitat groups on our third floor? Groups we sometimes found in glass cases in private houses, but they were assembled for their beauty rather than their scientific accuracy. But it was from the private collection of Mr. E. T. Booth of Brighton, England, that the idea of groups permeated to the public museum, and Mr. Booth's collection can still be seen in England's "Atlantic City," for he bequeathed the collection to the town in 1890.

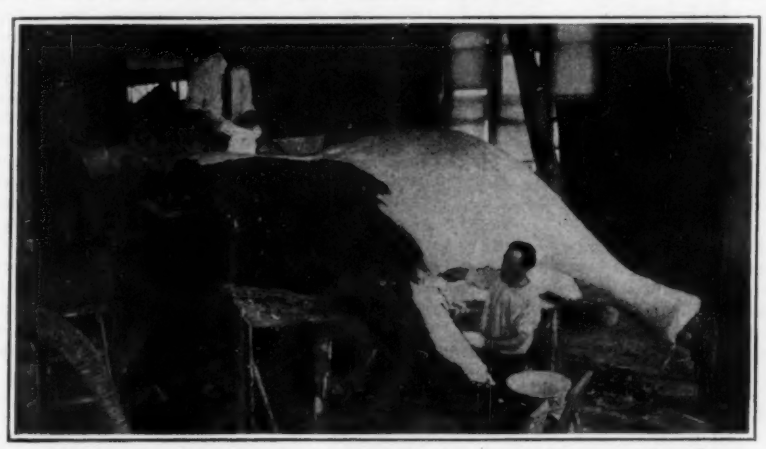
Great names now crowd in on us—R. Bowlder Sharpe, who installed the first "habitat" group in the British Museum before the natural history collections were transferred to South Kensington where Sir William Henry Flower carried on the good work. In this country the new idea was brought forward by that prince of museum curators, Dr. G. Brown Goode. The old idea of a pedantic naturalist was gradually crumbling to pieces, and we were emerging from an atmosphere of dust and darkness. Now, here I might refer to a pioneer group which was exhibited across the Park in the old Arsenal building in 1869. An Arab courier, attacked by lions, was theatrical and bloody, but drew the crowd and instructed, even if it did freeze the spines of the children.

Strange to say this group, which was the first group owned by this Institution, is now in the possession of the Carnegie Museum of Pittsburgh. This group was prepared by Jules Verreaux, a French naturalist, to whose influence we owe the great private natural history establishment at Rochester, from which incubating ground we have such graduates as Hornaday and Akeley. The primitive group was followed in 1880 by a group of Orangs mounted by Dr. Hornaday. The technique of animal mounting was on the way, and we have a gradual evolution which may be briefly summarized as follows: The old method was to shape the legs, then reverse the animal, stuff with straw—stretching the hide to capacity, then put all together and fasten on a pedestal. Of course there was an outward resemblance to the animal when the wooden-like product was ready for the case. A built-up manikin followed, and there was more respect for the animal's anatomy. A great forward step was made when Dr. Hornaday shaped up a manikin of excelsior with the aid of twine, to hold the elastic material in place, and then clay was added so that the wrinkles might be preserved as in life.



The great African elephant group in the American Museum of Natural History

By far the most notable advance in taxidermy is the method devised by Mr. Akeley of modeling an animal in clay, copying all the folds and wrinkles of life, the molding of this in plaster and in this mold making a light and durable form, or manikin, upon which the skin is deftly placed, a method now in general use. All the resources of the carpenter, sculptor, and modeller are employed in the fabrication of such accessories as rocks, canes, trees, foliage, flowers, etc., and textiles, celluloid and wax were all laid under contribution in constructing this unique production.



Putting the plaster on the hide to hold the shape while preparing the internal lining

Getting a section of the hide ready for assembling by the Akeley method, the last word in taxidermy

If I digress from great animal groups and describe the methods of dealing with fishes and lower invertebrate life I should provide the material for more than one article, so I will only refer in greater detail to the new Akeley system, the latest invention of Mr. Carl E. Akeley, who is now in Africa getting specimens for the great African Hall, which will contain the Roosevelt and other trophies.

Now, the Akeley system sounds complicated, but it is simple when you understand the sequence of operations. Of course, you first "catch your hare," or have your specimen and the hide tanned with vegetable material, so that it is soft as possible. You then prepare, with the aid of a carpenter and a blacksmith, the necessary armature. You then apply modeling clay, which is, of course, kept wet all the time, as it crumbles if it loses its moisture, and model the general form of the animal that is to be reproduced. The next step is to apply the soft hide to the carcass in as large sections as possible. The sculptor then models all the lines and wrinkles *through the hide*; I italicize the word "through," as this is the heart of the Akeley system. The third step is to apply plaster-of-Paris to the *outside* of the hide, so as to make a hard coating or jacket which will hold the hide in place with its manifold wrinkles and lines. The sections of skin with their jackets are now taken off, the clay removed, and the inside of the skin treated to a coating of papier-mache and wire cloth, which adheres to the inside, preserving the wrinkles, etc., as did the plaster-of-Paris on the outside.

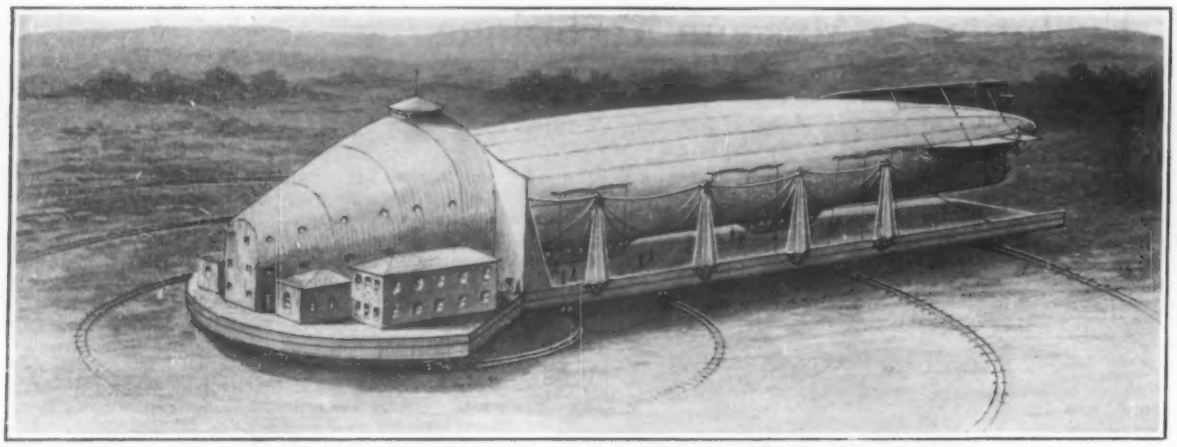
We now have the skin safely disposed between the two coatings—the plaster on the outside, and the papier-mache on the inside. Naturally, the plaster coating is the one to get rid of, so that it is very carefully chipped away and the great section of hide is ready for joining to the rest. A "manhole" is left somewhere, for it is little fun doing anchoring in the artificial interior of an elephant. Indeed, we can understand now how the soldiers in the horse of Troy must have felt, for the case is about the same. After every joint is closed with the skill of a furrier, the "manhole" is replaced and the whole animal is waxed and presented to the public.

There is no reason why a hide prepared by this system should not last for all time, for the animal, or group, can be cleaned like a marble statue, and has the advantage of not turning yellow.

Such is, in brief, the last word in museum technique applied to large animal groups, and while we never know what the future may have in store for us, still it would really seem that we had reached the goal.

The Formation of Spiral Nebulæ

IN an article on this subject contributed to the *Comptes Rendus* of the Paris Academy of Sciences, M. Alex. Véronnet examines the effect that would result from the impact of the two components of a binary system. He shows that the energy produced by the friction at their surfaces is the most important factor, and that a mass equal to that of Jupiter might produce by impact with the sun a temporary increase of light amounting to twelve magnitudes. Radiation-pressure would then expel the heated particles with high speeds, and the revolutionary movement of the stars would give a spiral formation to the scattered particles. The author seeks thus to explain the phenomena both of novæ and of spiral nebulæ. He concludes that the latter would undergo a rapid evolutionary transformation (in the course of a few centuries). It would seem, however, that the larger spiral nebulæ are on too grand a scale to be the product of the impact of a mere pair of stars. The hypothesis is, however, worth considering in relation to such nebulæ as that revealed round Nova Persei and Hubble's variable nebula in Monoceros.

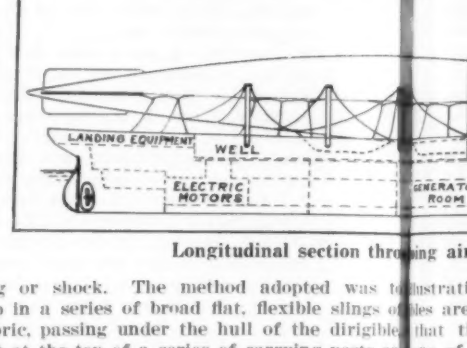


A landing platform which permits a dirigible to land head to the wind

The Problem of ...ri...

Proposed Method for the Safe ... of ... Them H... Wind

form for dirigibles, combined with a supply station, repair shops, and a lee tie-up in all bad weather. It consists essentially of a platform of sufficient length and width to carry the largest dirigibles. At its forward end the platform widens out into a circular head, which is about 200 feet in diameter. It is supported at intervals along its length by a series of flat cars which run upon concentric railway tracks, as shown in the illustration. At the forward end of the platform is built a semi-conical structure, which plays the part of shed and windshield for the forward end of the dirigible. On either side of it are built machine-shops and store-sheds. The windshield is lighted by port holes, and it is surmounted by a pilot house, from which the dock master, through radio telephone, keeps in touch with the pilot of the approaching airship, and controls the motors by which the mooring platform is moved. It should be explained just here that in the exact center of the circular head of the forward portion of the platform is a large vertical hollow spar pin, which engages a bearing set solidly in the ground. About this pin the whole structure rotates.

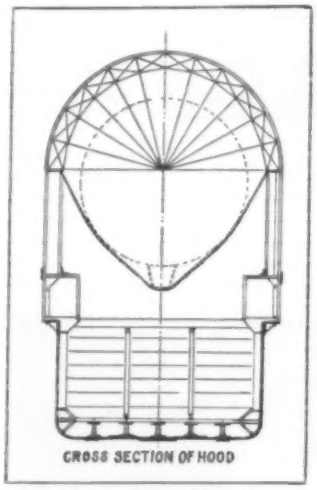


Longitudinal section through ...

A very nice point to be decided was how to hold a dirigible, three-quarters of whose body was exposed to the weather, with a minimum danger of severe straining or shock. The method adopted was to carry the ship in a series of broad flat, flexible slings of reinforced fabric, passing under the hull of the dirigible and made fast at the top of a series of carrying posts arranged down each side of the platform. Some of these slings, as will be seen from our drawings, extend under the hull from post to opposite post, so that they lie in a plane normal to the longitudinal axis of the ship, and others extend diagonally between the posts. The dirigible is held down against the slings and clear of the platform by means of vertical cables reaching from the hull down to the mooring rings along each side of the deck. By this arrangement the ship is held firmly, but flexibly, in place without coming into contact with any rigid parts of the platform or its gear. And the supporting contacts with the slings and cables are sufficiently distributed to avoid any tendency to break the ship in two.

EVERYONE who has followed the development of lighter-than-air ships must have realized that a large proportion of the accidents which have befallen them has occurred when these great structures were in proximity to the ground. Sometimes as the ship was emerging from the shelter of its shed, and before it was completely clear, a side wind would carry it against the side of the shed and cause a rupture of some of its members. To guard against this liability, lofty windshields of boarding were erected, in the lee of which the airship found quiet, or comparatively quiet air, and was able to leave and return to the hangar without the risk of collision with the shed.

The difficulties involved in entering a shed, when a side wind is blowing, is similar to that experienced by the big Trans-Atlantic liners if they attempt to warp inside the Hudson River piers when a heavy current is setting up or down the North River. In such cases it may take as many as a dozen powerful tugs to hold the big ship athwart the current, as she moves cautiously to her pier. The large liners, on this account, prefer to come up to their docks during slack water, at the turn of the tide. Similarly, the captain of an airship would prefer to make for the protection of the shed in still air, or when the wind was blowing along the length of the shed and parallel with the ship. Not many people appreciate the magnitude of the total side pressure upon an airship, due to its great length of six or seven hundred feet, and its diameter of seventy to eighty feet. The total area exposed is so great that, even in a moderate summer breeze, the total pull which the crew on the ground have to resist in a cross wind may readily exceed a score of tons.



Section through hood

There is a parallelism between the airship and the steamship, which has a significant bearing upon the problem of landing. Both are sustained in a fluid medium which is their natural home, and which they should never leave except when constrained to do so by sheer necessity—that is to say, neither the steamship, nor the airship, should touch solid ground, except under special conditions, and when every precaution has been taken to avoid damage or disablement. The steamship's hull is not designed, primarily, for contact with the land, but rather to rest on a yielding fluid. And of all the dangers of the sea, there is none which the ship's captain avoids so carefully as that of bringing the comparatively frail hull of his ship in contact with the ground, whether it be a rocky shoal, or the smooth flat surface of a sandy shore. When the ship does have to rest upon the land, she is taken into an expensive and specially designed drydock, where, as the water is pumped out, she comes to a bearing, very slowly, upon a bed of timber blocks, which have been so distributed over the floor of the dock as to avoid any excessive pressure being brought to bear upon any particular part of the vessel.

If the reader has ever witnessed the docking of a big ship, or any ship for that matter, he must have been impressed with the extreme care with which the operation is carried through. Very slowly does the vessel come up the channel and enter the yard where she is to be docked, and even more slowly does she creep up to the dock entrance under the watchful eyes of the officer on the bridge, and of the docking master ashore. Now all of this caution is based upon the fact that the ship is a huge and heavy structure, with a comparatively light and fragile shell, which would be heavily strained, if not broken, when a too sudden contact with a pier or any solid and immovable object would arrest the great momentum in the moving ship, with disastrous results.

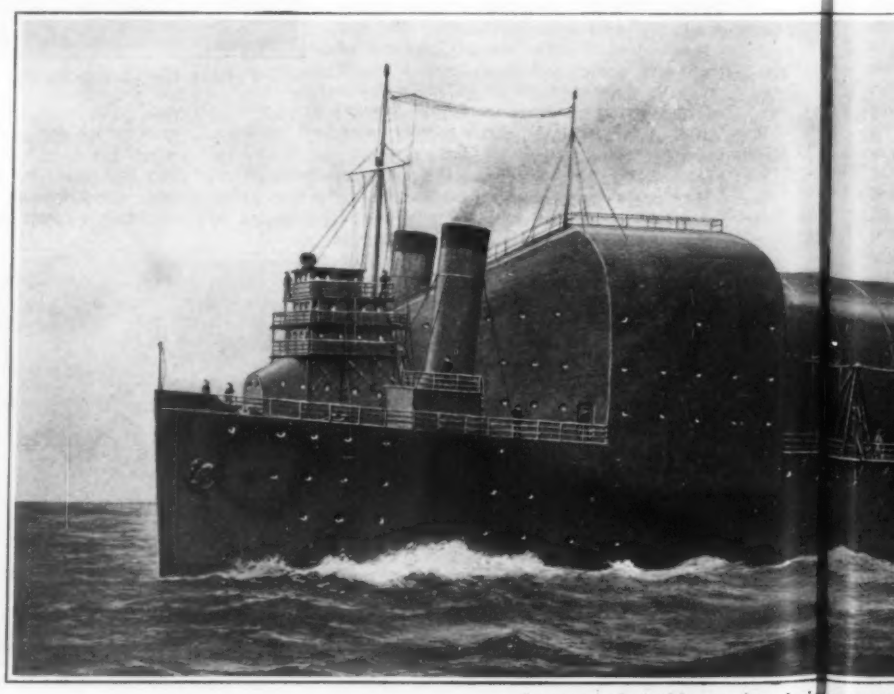
When a ship of the sea is not tied up to a dock, she is moored by the head, in water of sufficient depth to float her at all times, and with a sufficiently large unobstructed area of water around her mooring to permit the vessel to swing head to wind, or head to tide. Under these conditions, the primary pressure upon the ship is only a fraction of what it would be were either the tide or wind, or both together, moving athwart the vessel's position.

The above conditions, as they effect the ship of the sea, apply *pari passu* to the ship of the air. She should as far as possible float in her native element, and be sent into drydock (in her case the airshed) only when it is absolutely necessary. It is desirable, when she goes into port, to prevent, if it be possible, any direct contact between her delicate hull and the solid mother earth. Moreover, in starting on a trip, or in returning, or while she is in port, it is desirable that she should move up the wind to her mooring, and as far as possible be free to swing head to wind while anchored.

With a view to meeting these requirements the Vickers Company developed the lofty mooring mast, as first suggested many years ago by the SCIENTIFIC AMERICAN. This mast is a stout latticed steel structure, to the top of which the air ship is moored by a cable which extends from the mast to the nose of the ship. The sheave at the top of the mooring mast, through which the mooring cable passes, is arranged to swing in a horizontal circle, and the moored ship is free to swing at all times head to wind. Experience has shown that, because of the streamlining of the dirigible, the stresses upon the mooring cable, and upon the nose of the airship, are moderate; and it has proved to be an easy matter for a crew of three or four men to maintain the ship on a level keel. Vessels have been moored in the open in this way for several weeks on end, during which they have ridden out some severe gales without damage.

We present on these pages illustrations of two different types of airship mooring; one for use on shore, and the other on the water, which the designer, Mr. John Mason of Cape May City, N. J., has developed with the idea of combining the head-to-wind advantage of the mooring mast with certain of the facilities which attach to the fixed airship shed.

In the design shown, in the top left-hand picture, provision is made for an all-the year-round landing plat-



A proposed airship carrier, desi... accompa...

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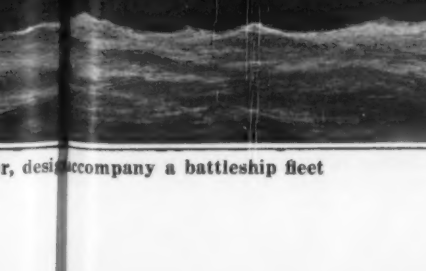

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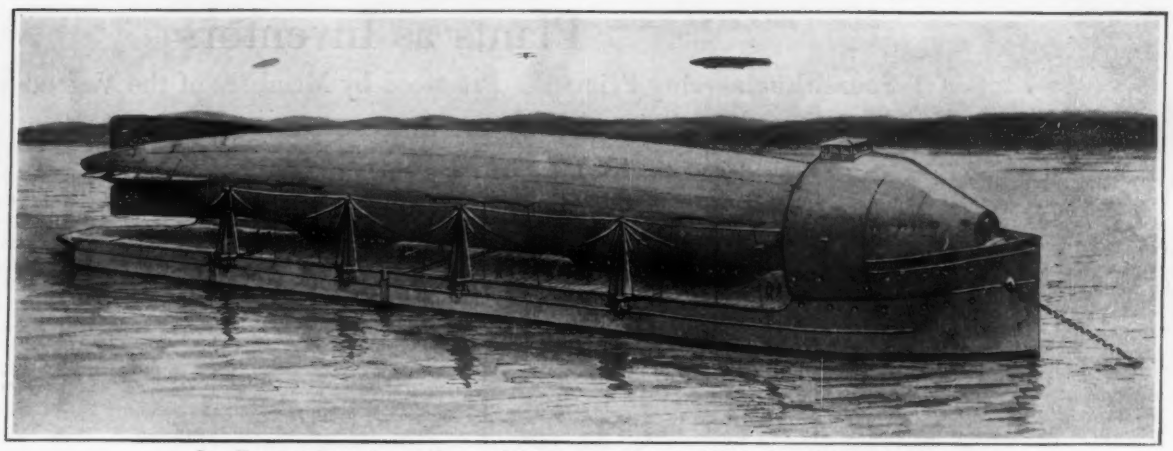
A Mooring Barge for Dirigibles

principles of construction used for the radial platform on land, are used also in the mooring barge, which is represented in the right-hand illustration on this page. There same hood, or windshield, surmounted by its house; the same series of posts ranging down sides of the hull of the pontoon, and the same of supporting the slings is employed. The consists of one large pontoon, with as many ones attached behind it as the length of the requires.

ill be seen at once that the head-to-wind con- are insured by mooring the pontoon from The mooring ground would, of course, be d where there is no strong tide or current, and be located, preferably, in the back waters of har- r upon lakes that were conveniently available. In of the mooring pontoon, the machine shops, stor- r spare parts, accessories, fuel and other facilities and shed are provided for in the forward portion



Landing pontoon, in sections, which carries the airship in broad flexible slings

A Sea-going Dirigible Transport

The most normal and daring proposal of Mr. Mason is to build the great dirigible mother ship which is shown in the adjoining illustration. When we remember that the largest dirigibles are about 700 feet in length, it will be understood that the proposed ocean-going ship to house and accompany a battleship fleet must itself approach in size of these largest steamship dimensions. The wash drawing and the line drawings of this vessel will make clear what the designer is attempting to do. The mother ship would be a steel vessel about 800 feet in length by 90 to 95 feet in width. Forward and 40 or 50 feet from the stem-platform will be a three-deck bridge structure, containing the pull down accommodations for the captain and officers on the lower deck. By this the chart room and the captain's staterooms on the intermediate deck, and the pilot-house and bridge on the top deck. Abaft this structure, one on each side of the windshield, will be two elliptical funnels, with uptakes to avoid the compartment aft from the bow. Abaft of the boiler room is the generator room, with the firemen's mess located on the deck above. Aft of the generator room are the blower room, and a compartment in which is housed a powerful gyro stabilizer. Further aft are machine shops, store rooms, etc. Electric cables lead from the generator room to the electric motor room, which is located in the last compartment but one toward the stern.

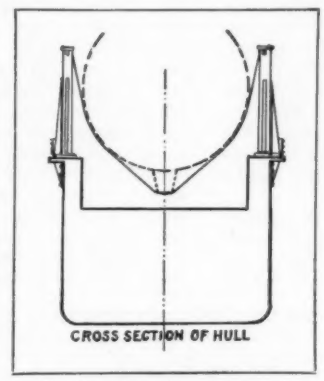
Down the sides of the ship will be noticed a series of tripod masts, from which the various belts of the carrying crate pass below the hull of the airship.

The use of the electric drive insures that there will be ample electric power for the manipulation of the many winches, to which the landing ropes of the dirigible are led, when she is leaving, or returning to the mother ship. In making a landing the mother ship will steam head-to-wind, and the dirigible will do the same, coming up over the ship until it is possible to drop the mooring cable on deck. Here it is fastened to a cable which leads forward into the nose of the windshield, where turn is taken around a powerful electric winch. As the airship descends closer to the mother ship, other landing ropes are dropped and carried to electric winches; the result being that the dirigible, in spite of its great size, is gradually pulled down, against its positive buoyancy, into the carrying slings, and there made fast.

We have spoken of this mother ship as a daring proposal, and such it is; but the designer is taking a long look ahead, and he believes that if two of these ships were built, and given sufficient speed to accompany the main fleet, they could provide four large dirigibles for such operations, no matter how far afield the fleet might venture in search of the enemy. Mr. Mason believes that two such ships could maintain four dirigibles, for the reason that while two were in the air, the other two could be refueling and undergoing such overhauling as was necessary.

The question of stability, of course, would have to be carefully watched at all times, but the fuel supplies, and the free use of water in the double bottom, should take care of that problem.

These three designs are presented as being a thoughtful study of one of the biggest, if not the greatest problem—namely, that of landing and housing, which confronts the large airships of today.



Section showing well and cradle

The Relation Between Body Size and Organ Size of Plants

IN the *American Naturalist* for October, 1921, Dr. Edmund W. Sinnott of the Conn. Agricultural College presents a paper on the relation between Body Size and Organ Size in Plants.

In the animal kingdom, particularly among its more highly specialized members where the primitive condition of infinite multiplication of smaller organs has given way to a high degree of differentiation, there is necessarily a close correlation between the size of a given organ and the size of the organism of which it forms a part. A particularly large individual will tend to have proportionately large bodily structures, and *vice versa*. In the case of the higher plants, however, with their multiplication of similar organs and their notably lower degree of organization and individuation, an interdependence between body size and organ size is certainly much less obvious. We need only to call to mind the general similarity between leaves or fruits from small and large trees to realize that in these larger, woody plants, at least, there is no very striking correlation between the size of the body and the size of its parts. In certain herbaceous forms, however, evidence has from time to time been brought forward that such a correlation does in fact exist and that the largest plants (whether measured by dry weight, height, number of stalks or yield) are those which bear the largest fruits and seeds. The author's paper is the result of a study of a group of 562 bean plants growing during the summer of 1918 as a part of a larger investigation. The beans were Red Kidneys, and although they were not members of a pure line, they were so similar in all characters studied as to indicate that no wide genetic differences existed among them. Seeds of uniform size were selected and were planted June first. The soil of the plot varied decidedly in fertility, with the result that some of the plants grew luxuriantly, many of them reaching a total dry weight of 150 grams, whereas others were much dwarfed, reaching only 4 or 5 grams at maturity. The bulk of the population was intermediate in size.

Over two hundred of the plants were harvested from time to time during the summer, representatives of all stages from the young seedling to the appearance of flowers being obtained. The rest, 344 in number, grew to maturity and were harvested then. The number of leaves, pods and seeds were counted and dry weight determinations made of the total bulk of the leaves, of the stem system and of the yield of fruit, separate determinations being recorded for total pods (without seeds) and total seeds. From these data, the dry weight of the entire plant, of the vegetative shoot and of the reproductive structures could easily be determined, as well as the average weight of leaf, pod and seed for each plant. Correlations were then made between the average weight of each of these organs, respectively, and the size of each plant. The latter was represented either by the weight of the shoot (stem plus leaves), the weight of the fruit (yield), the number of leaves, the number of pods or the number of seeds.

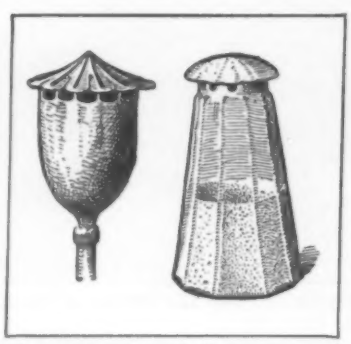
The author presents a number of correlation tables, study of which leads him to conclude that the size of the plant body is not the direct causative factor in determining the size of the leaves, fruits or seeds which it produces, as has been suggested or implied by many investigators, but that the size of any given organ depends rather upon the size of the growing point out of which it has been developed. Any factor, be it age, moisture or food supply, which alters the size of the meristem, will thus alter the size of the organs produced by this meristem. There seems to be nothing in these higher plants closely corresponding to the definite organization in the animal individual, where size of body is definitely related to size of organs.

Plants as Inventors

Sound Engineering Principles Practiced by Members of the Vegetable Kingdom

By Dr. Alfred Gradenwitz

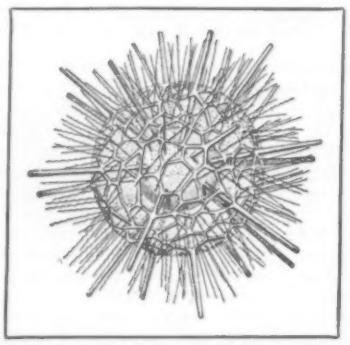
WHEN, about 30 years ago, the validity of statical and mechanical relations was first discovered in the realm of botany, experimenters, truth to say, marvelled at the unexpected agreement between the inventions of human engineering and the devices employed by vegetable as well as by animal organisms; but they dared not face the conclusion that the same invariable law manifests itself in the structure of living beings as well as in the creations of man. A more plausible hypothesis was found in the belief that the products of Nature are rough approaches to human achievements, the perfection of which, so far from causing us to regard Nature as a superior teacher of man was the subject of universal admiration.



The seed caster of the poppy, and an adaptation to household and medical purposes

In a book both attractive and instructive ["Die Pflanze als Erfinder," Franckhsche Buchhandlung, Stuttgart], Professor R. H. Francé, on the contrary, suggests that human engineering never could do anything beyond obeying the law of cosmic structure as well as of living plasma, that the inventions of Nature far outdo, from the point of view of many-sidedness, perfection and efficiency, those of the human mind, and that no more fertile task could be imagined than deriving knowledge and suggestion from the infinite series of natural models.

The seven constructive elements — sphere, crystal, plane, staff, band, screw and cone—the same elements on which human engineering is based, are found again in Nature's own creations. To her, as well as to man, they are the indispensable fundamental elements, and neither Nature nor human art or engineering knows of any form that could not be reduced to them.



One of nature's characteristic forms which is in fact a marvel of stability and economical construction

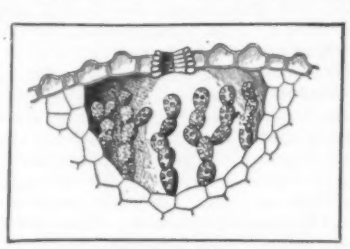
"On my writing desk," says Francé, "there is a bunch of fresh wild flowers looking at me. Every week they are different, . . . each time a handful at random taken from the midst of Nature's life. With a marveling mind, I am analyzing their forms: Leaves and petals are planimetric surfaces, the crowns of campanulas show the rounding of spheres, the forms of cones are combined with plane surfaces. The same as in a rococo ornament, the conchoid and helical surface, both derived from the spiral are reverted to, time and again; the stems are rods—all fundamental elements, though bearing the stamp of reasoned life, are developed and complicated to the highest possible degree, but after a quarter of an hour's searching and thinking I have failed to detect anything but the seven fundamental forms of the universe, and I give up any further attempt in dispair."

Francé was in a most remarkable manner led to these considerations. Being in need of a shaker for the sake of a biological experiment, and having in vain tried to obtain it in trade, he was eventually struck by the idea that Nature, for the spreading of spores and seeds, ought to have created something suitable. In fact, the capsule of poppy turned out to contain what he was looking for; the holes arranged below the lid of the capsule actually constitute a solution of the problem superior in efficiency to all human constructions previously put forward. Francé was the first to find this by actual experience, and a patent applied for to protect a caster accurately imitating the natural product was readily granted.

"This is," says Francé, "how a new science sprung up, the science of Biotechnics," whose task it is to investigate the mechanical attachments of Nature and to derive therefrom suggestions for human engineering.

A fact which, according to him, can be stated quite generally, is that every process in Nature occurs in the most advantageous manner, that is to say, with the maximum possible efficiency: "The shortest way in which a process reaches its end is its natural law: the smallest resistance offered by an object to the production of its permanent state of rest is obtained by assuming its most suitable form, *i.e.*, its functioning in a mathematical sense." The same fact could be expressed in a more simple and commonplace way by saying that "to every process corresponds a given technical shape."

The correctness of this proposition can be confirmed already in connection with the cell, the fundamental element of all organisms: Being liquid and plastic, the protoplasm possesses the faculty of assuming any shape corresponding to the actual function of the cell. Whenever, however, the cell remains at rest, as soon as all processes within it have come to a temporary standstill, it necessarily reverts to "the prototype of all shapes, the sphere."



A vegetable power-plant from the moss Marchanita, in which the sunlight is made to give up its energy

Generally speaking, shape enables function, the cause of shape, to be ascertained. The various *crystalline* forms, accordingly, are the expression of given conditions of stress and pleasure, which under otherwise equal circumstances always obtain in the same manner. Everything intended to exert a pull must be *band*-shaped, muscular fibres as well as driving belts. In fact, bands are the most advantageous technical realization of pulling organs. *Staves* will alone serve as supports: The same as the old man leans on his staff, the same as a temple roof rests on staff-shaped columns, palms grow column-like trunks to rest their crowns upon, corn will balance its ears on stalks that are hollow staves, and the most minute mono-cellular organisms will put forth staves, "whenever supporting functions belong to their habits of life."

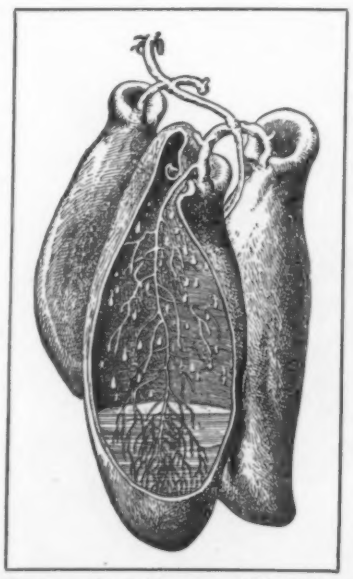
The *helical shape*, in its turn, is the only possible in the case of drilling effects, whenever there is anything to be pierced. "The tiny microbe will thus screw its way through the world of the water drop, the dreadful *spirochaeta* is by its helical shape enabled to penetrate all tissues, to get between all the cells of its victim, the light, helical form of the winglets of maple fruits serves for aerial propulsion just in the same way as airplane propellers and just the same as the enormous propeller screw of ocean steamers serves for 'screwing' through water."

"In fact, it is not we who, after all, have invented screws, drills, propellers, neither is it the microbes and mastigopods and plants, nor finally the air, which, of course, moves quickest in helical whirlpools, —but above all facts of Nature there is ever towering a law intimately based on the structure of the world, that movements occurring in spiral lines will overcome resistances more readily than movements in straight lines, and that, accordingly, movements will take place much more frequently when adapting themselves to the form of a spiral than in the opposite case."

"Crystalline forms, sphere, plane, staff and band, screw and cone, these are fundamental engineering elements of the whole universe. They are sufficient for all processes of the whole of cosmic life, controlling them in the best possible manner. Whatever there is, is some combination of these seven fundamental forms, though there is nothing beyond the holy seven. Nature has produced nothing else, and the human mind will create whatever it may, without ever reaching anything but combinations and variations of these seven fundamental forms." In fact, "the laws of minimum resistance and of economy will cause the same activities always to result in the same forms, so that throughout the whole universe all processes will always have to occur within the compass of the seven forms of all being."

In the further course of his treatise, Francé discusses a number of typical vegetable organisms, first of all, the flagellates or mastigopods, which according to the law of minimum resistance, always assume the form of a narrow hull adapted for dividing the water. Floating as they all do below the surface of the water, they constitute the prototype of submarine. In the place of the keel otherwise provided, many such organisms (which are known to be at the boundary between the vegetable and animal kingdoms) comprise an attachment serving as rudder as well as for increasing stability, of which modern shipbuilding has not yet made use, but which is to be found with airships. When being shown by Francé the design of a ship imitating the shape of such a mastigopod, one shipbuilding engineer was most surprised at noticing a type of vessel so far unknown, but which with equal coal consumption, would be able to obtain higher speeds. "The solution of the problem of ship motion by the whip-shaped screw of flagellates," says Francé, "is an ideal case of economic achievement. While, in order to obtain a speed of, say, 23 knots per hour, engines of 40,000 to 70,000 h.p. with an enormous consumption of coal, must be resorted to, a tiny monad, according to my calculations, in proportion to its size (the monad being assumed to be 1/100 millimeter, the rapid steamer 200 meters in length), will obtain, not a speed of 4.2 millimeters per hour, as corresponding to the best of our rapid steamers, but effects 80,000 times better! In fact, the monad, with the aid of its whip screw, is able to hurry through 20 millimeters per second. . . So very much superior are organic structures to those of human engineering, and such possibilities are opened up by the way entered on with the foundation of biotechnics!"

Natural models of the most diverse turbine types are offered by the sea in these minute plants by millions floating at its surface and at most measuring a fraction of a millimeter, which are termed *Peridineæ* and which, out of cellulose, build for themselves an armor, some sort of controlling apparatus by which the motion of the surrounding water is forced into given paths, thus causing the whole body to rotate like a turbine rotor. Each of the 160 species of *Peridineæ* known to botanists constitutes a modification of its own of the turbine principle, whereas engineers at most know of a dozen turbine types. The design of turbines thus might, in its turn, derive ample suggestion from biotechnic studies. Nor should it fail to take into account the *Diatomaceæ*, constituting ingeniously designed minute turbine ships.



The urn-shaped leaves of Dischidia, which constitute an ideal refrigerating machine

Francé further draws attention to the fact that the membranes of vegetable cells normally will stand a pressure of 5 to 10 atmospheres, that is, the same as the walls of a small steam boiler. Nay, in the cells of sugar beets a membrane 1/1000 millimeter in thickness stands a pressure of 21 atmospheres, and whereas a steam boiler requires walls of a thickness about 1/20 of the boiler diameter, those of the vegetable boiler are barely thicker than 1/500 of the diameter. To this point is Nature's own engineering superior to that of man.

A simple *vegetable leaf* further combines in itself the installations

of a large modern industrial plant. In it, there is a complicated ventilator at work, further a drying apparatus, an infinite number of admirable "light engines," a refrigerating machine and an hydraulic press. Most remarkable among these are the "light engines," having no equivalent in human engineering, viz., attachments by means of which the chlorophyll will catch the carbonic acid and with water convert it into starch, in which connection the beams of light play the same part as the steam in a steam engine. The vegetable leaf thus works with the cheapest, most ubiquitous source of power, the energy of sunbeams, and likewise with the least expensive of raw materials, air and water, which are found everywhere. Moreover, vegetable refrigerating machines have been shown by Francé to embody the principle of the Linde ice machine; if deprived of their refrigerating mixture, they would constitute excellent condensers.

Francé draws attention to the "waterworks" of trees, which, in spite of all attempts so far made, have remained unexplained, installations by means of which, *e.g.*, the mammoth trees of California will raise the life-giving water to a height of 142 meters, the eucalyptus of Australia even to 152 meters, an achievement not even approximately equalled by human waterworks.

The most hopeful conclusion derived from Francé's considerations is that human engineering could keep itself busy for centuries to come, creating an infinite wealth of new and ever more improved machines, if only the more important vegetable inventions so far known were to be assimilated.

It is not the plant that creates its technical apparatus nor the human mind that produces marvels of engineering, but in both of them unconsciously to themselves there is the same principle at work.

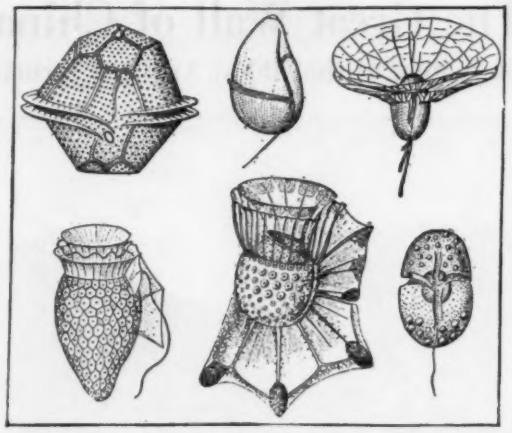
Gravitational Absorption

MAJORANA, in an interesting series of contributions to *Atti della Reale Accademia dei Lincei*, abstracted in *Philosophical Magazine*, 39. 488, 1920, has proposed a new theory of gravitation, in support of which he offers experimental evidence adduced from certain delicate pendulum demonstrations. He assumes that matter is not completely permeable to the gravitational force, but that the latter is to some degree weakened in transit through all material bodies. Where, under the Newtonian law, the attraction between two particles is equal to the product of k, the ordinary gravitational constant; M_1 and M_2, the respective masses; and the inverse square of the distance r: Majorana attaches a further factor, in the form of the natural logarithmic base, e, carrying a negative exponent that is numerically represented as the definite integral of $h\theta dr$ over the entire line r; h being a second universal constant of gravitational absorption, and θ the density of the intervening matter, numerically or as a function of r, as the case may be.

In consequence of this absorption, the attraction of any large body upon objects outside it would be diminished, and its "apparent mass," measured by means of this attraction, would be less than its true mass. Dr. Russell, familiar to the readers of our astronomy page, investigates some of the astronomical consequences of Majorana's theory in a recent issue of the *Astro-Physical Journal*. He finds that, on the hypothesis that there will occur no change in the inertial masses, the value of h determined by Majorana (6.73×10^{-12} in c-g-s units) would, under the most favorable conditions, result in a displacement of Jupiter from his position as ordinarily calculated more than 500 times the lower limit of observation, while the whole lunar theory would be wrecked by a similar effect of 10,000 times greater than the smallest we could hope to note. Moreover, if we assume that, with this value of h, the apparent mass takes the place of the inertial mass for gravitational purposes, the tidal phenomenon on the earth's surface would vary, as between the time when both sun and moon are below and when they are both above the horizon, by an amount exceeding the observed difference by more than 5000 times the observational limit.

With these results he couples the very obvious statement that, dealing as he does with an apparent change in weight amounting to one part in 12000 millions, Marjorana cannot possibly hope to cut down the effect in question by 5000 or 10,000 and keep it above the threshold of observation so far as laboratory determinations are concerned. His whole theory must therefore fall, not merely the volume of h which he proposes.

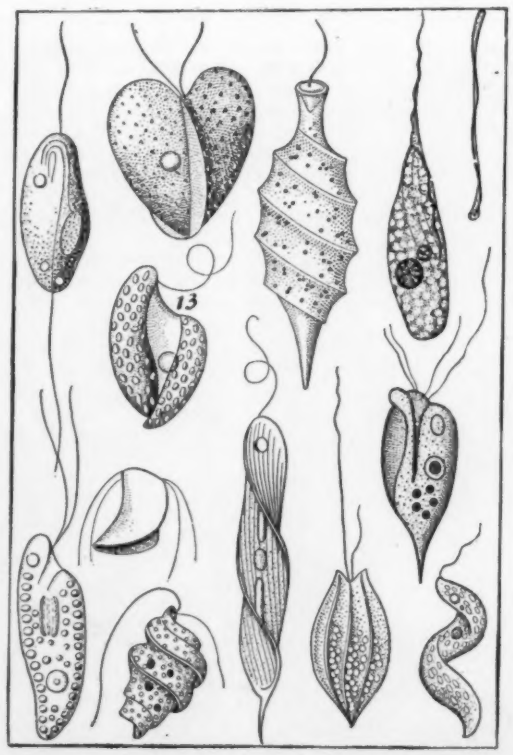
But what then becomes of Marjorana's long and careful series of experiments? If their result is accepted, it seems necessary to interpret it as showing that the *mass* of one body (his suspended sphere of lead) was diminished by the presence of another large mass (the surrounding mercury); that the effect was a true change in the mass (since inertial mass and gravitational mass are all the kinds of mass that we know of); and that it depended on the proximity of the larger mass, and not upon any screening action upon the earth's gravitation.



Peridineae of the sea, natural turbine models to which Prof. France attributes an efficiency greatly in excess of any man-made turbines

Strange as this notion may seem, it is not inherently absurd. Indeed, if the phenomena of gravitation and inertia may be accounted for by assuming that the four-dimensional "world" possesses certain non-Euclidean properties, or "curvature," both in the presence of matter and remote from it, it is not very surprising if the curvature induced by one mass of matter should be modified to some degree by the superstition of the curvature due to another, so that the effects were not exactly additive.

A great variety of assumptions may be made regarding such an influence, and many of these might have the advantage of giving a conservative field of force, which Majorana's did not. Complications are still likely to arise. For example, consider a large spherical mass, alone in space and gradually contracting upon itself while it moves forward in a straight line. Its mass will presumably diminish as its various parts come closer together; but what will happen to its velocity? Presumably this would increase, but it seems obvious that either the conservation of momentum or the conservation of energy would have to be abandoned, if not both. Come next to a planet revolving in an eccentric orbit about the sun. Its mass will diminish at perihelion, and this will probably lead to changes in its orbital velocity. The resulting alterations in the orbit will depend on the law of change of velocity, and it might be possible to invent a law which would lead to conclusions consistent with observation.



A collection of flagellates embodying the prototype of the submarine, together with numerous helical shapes admirably suited for locomotion

Further speculation on such matters seems, however, to be premature, when it is considered that the whole structure would rest upon the observation of a change in weight amounting to one part in 12000 millions. Discussion of the possibility that some undetected systematic error has crept into the results, in spite of the great care taken to eliminate such errors, or to correct them, must be left open. It is to be hoped that the further experiments which Majorana contemplates will provide the data regarding the actuality, the magnitude and the laws of variation of the suspected influence, which now are so evidently desirable.

Ecological Relations of the Eskimo

IN *Ecology* for April, 1921, Dr. W. E. Ekblaw, Geologist and Botanist of the Crocker Land Expedition, offers a most interesting article on the ecological relations of the Polar Eskimo. The author says, in part:

The Polar Eskimo, who inhabit the northwest portion of Greenland contiguous to the waters of Smith Sound, are the northernmost people in the world. Along 800 miles of desolate shore, from Cape Seddon in latitude 76 to the Humboldt Glacier in latitude 79 degrees north, they have persisted for centuries as a unique little social group of about 250 individuals, quite successful in their hard struggle for existence by an almost perfect adaptation to the rigorous conditions of their far northern homeland. Their number, determined by the years of minimum food supply, has probably never been much greater or much smaller than now.

Their homeland, though extensive, is small in area because the Greenland ice-cap, which covers practically all the high plateau of Greenland, restricts all life to a narrow belt along the shore, free of ice and snow during the short summer. Their climate, though Arctic, is essentially oceanic. The periods of continuous day and continuous night are longer than those with any other people.

The Eskimo are a distinct race with distinct character, language and culture. Small of stature but of powerful physique, the Eskimo compare favorably in physical development with the most splendid races in the world. They possess some characteristics of the North American Indian in form and figure. Some characteristics link them with the Mongolian. Nevertheless they are a distinct race, with their own distinctive language and their own peculiar culture. The total number of Eskimo probably does not exceed 40,000.

The Polar Eskimo constitute a relic of the last wave of migrants which swept down the west Greenland coast subsequent to 1000 A.D., displacing the Norse Settlements then established there, and a later element introduced in the middle of the nineteenth century by an immigration of several families from Baffin Land, who introduced new elements into the culture of the natives, and profoundly modified their mode of life.

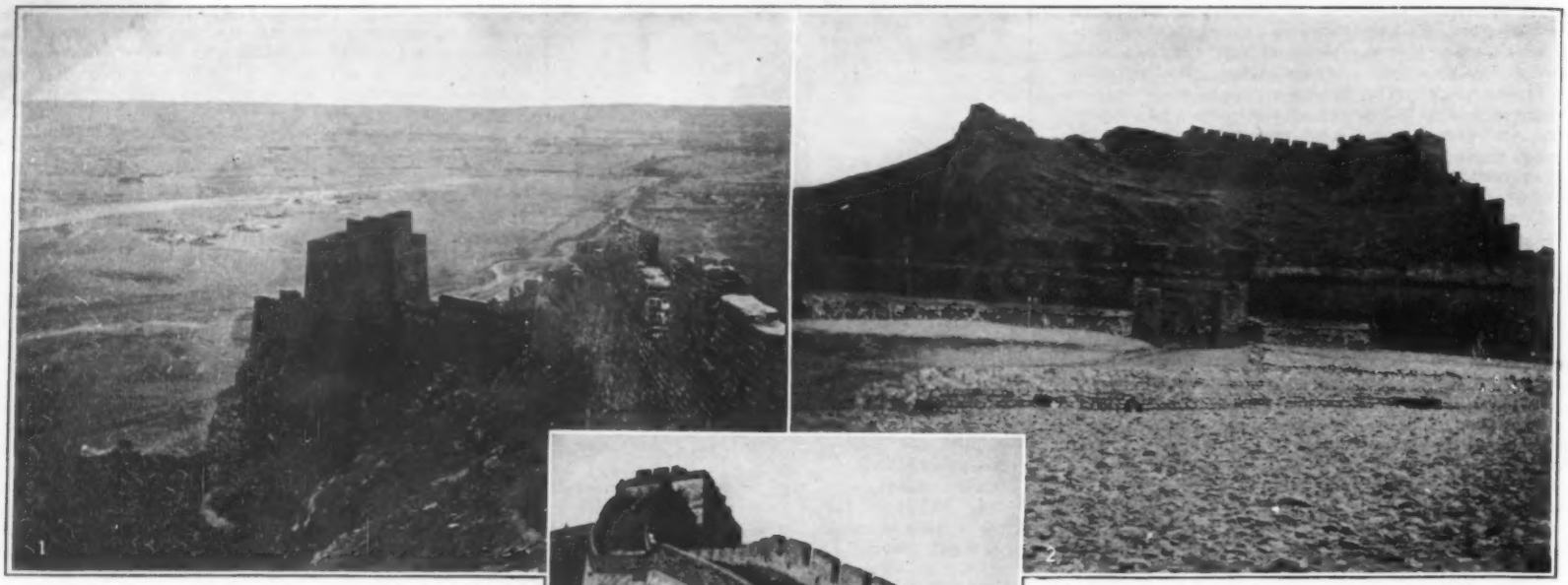
As a consequence of these two elements in the group the Polar Eskimo exhibit two distinct types. One of these, represented by the descendants of the earlier settlement, is characteristically Eskimo—short and stocky of stature, round and flat of face, flat of nose, stolid of countenance, and with a tendency to *piblokto*, a form of Arctic hysteria. The other type, represented by the descendants of the later immigration from Baffin Land, is suggestive of the Indian—taller, lither body, higher cheekbones, longer face, almost aquiline nose, alert countenance, and absence of *piblokto*.

Various factors, climatic, biotic, etc., are then discussed, and the conclusion is reached that to the environment in which the Polar Eskimo live, their every thought, their every activity, is adapted. Their character, their culture, their industry, are determined by their habitat.

However, recent contact with the white race is changing the Eskimo's mode of life, his culture, his character, so that they are no longer solely the effect of his environment. The introduction of lumber and iron has improved his sledge so that he can travel farther. The primus stove and Standard Oil Company kerosene have further extended his activities and his range of travel. Rifles and ammunition have transformed his hunting methods and increased his stores of food, clothing and fuel, and made hunting and living easier. Needles, and thread, and cloth, and cooking implements have immeasurably aided the Eskimo women. Tea, coffee and tobacco are insidiously weakening the Eskimo physique. By contact with foreigners the Eskimo is losing his native honesty, independence and sterling character. He is changing so fast that in another decade or two he will be quite another person. His direct relationship to his homeland will be lost and his dependence upon the exterior world finally established. The demoralization of the Polar Eskimo as a distinct social unit is imminent and inevitable.

The Great Wall of China

A Geologist's Examination of the Oldest Artificial Structure in the World



Three views of the Great Wall of China at widely scattered points

THROUGH the courtesy of Mr. Frederick C. Clapp, a well known petroleum engineer who has carried on some interesting explorations on the Great Wall of China, we are enabled to reproduce these splendid photographs; and the text, too, is abstracted from Mr. Clapp's paper in the *Geographical Review*. That the wall is actually the oldest extant artificial structure is of course not the case; that it must, in the eyes of anyone who gets a comprehensive view of it, stand as the most impressive landmark on the face of the earth, is evident. Not in its height and breadth alone does it appeal, but in its length and continuity, and in the magnitude of the task which was accomplished in its building twenty centuries ago.

Starting at Shanhaikwan on the Gulf of Liaotung, the massive masonry and brick wall runs far into the interior of the country. It maintains a uniform direction for hardly a single mile. It climbs mountains and crosses valleys, and is so crooked that to reach the eastern bifurcation near Sihai, an air-line distance of 125 miles, it takes a course of about 300 miles.

An adjunct to the wall, known as the Palisades, began on the Yalu River and connected with the wall proper on the Manchuria border north of Shanhaikwan. This line is given on many maps as that of a ruined wall; but Mr. Clapp crossed it without finding any trace of it, so it is evidently not everywhere preserved. There is historical record that it extended for at least 400 miles into Manchuria.

At Sihai, about 40 miles north of Pekin, at an altitude of 3300 feet, the wall branches, the inner loop trending southwest while the more northerly branch continues its mountainous way across western Chihli and the whole breadth of Shansi province to the Hwang Ho, where it rejoins the other loop. This distance in an air line is 380 miles, but the northern wall uses up 500 miles in covering this ground, while the southern loop, with a branch that runs off to the south, is some 630 miles long.

This double wall marks the region of greatest menace from the Mongols. Along the northern course, brick watch-towers and signal stations mark all the prominent hill-tops; and from these, we may conclude, signals were flashed whenever the invading horde had succeeded in breaking through the outer barrier.

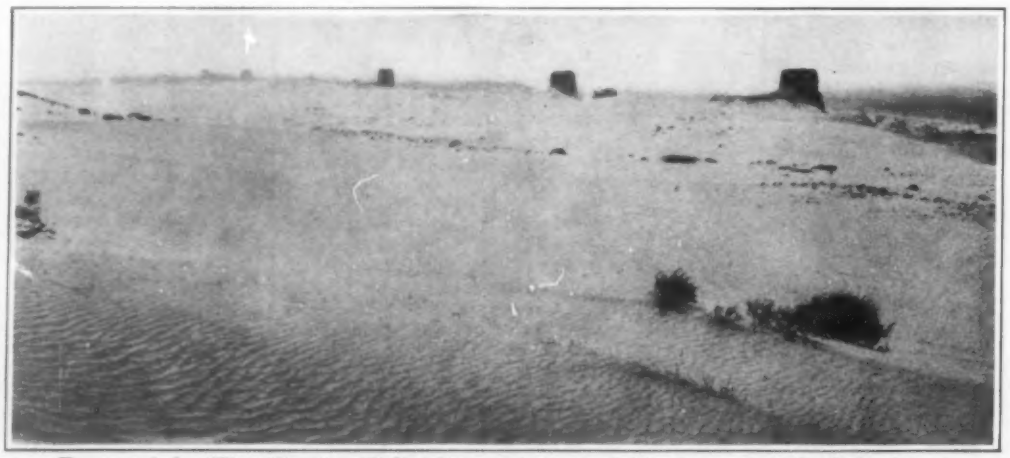
Without going into too great detail as to the further course and the branches of the wall, we can state that Mr. Clapp traces the main course of the barricade for 1350 miles further, far into Chinese Turkestan, with 750 miles of branch wall in Tibet and other regions. So he finds for the main wall a length of 2150 miles, and for its branches a total of 1780 miles—3930 miles of construction altogether. This is comfortably in excess of the length attributed to the wall by Chinese legend, and more than double the most conservative estimates of previous explorers. The highest figure ever before stated, including branches, appears to have been 2500 miles.

Little has been written on the Great Wall in a comprehensive way, says Mr. Clapp, and for that reason many misapprehensions exist as to its position, extent, preservation, history, etc. In the first place, one must not suppose that it is a structural unit, or that it was constructed all at one time. A number of separate walls, dating back several centuries, had been constructed bordering on the domains of the savage Hsiung-nu before the reign of the so-called "First Emperor," Hwang-ti, who buried alive hundreds of scholars and burned nearly all the books of the Empire. One of the separate walls, for instance, was built as early as the year 469 B. C. by Prince Chung-shan. The "First Emperor" (246–210 B. C.) in reality united and strengthened existing walls, and there is no doubt that during the past 2200 years the Chinese have built various Great Walls of as many varieties of construction. Some repairs were made as late as the beginning of the Ching (Manchu) Dynasty, since when no attempt has been made to keep the wall in repair.

The height of the Great Wall averages 22 feet, but varies from 20 to 50 feet; the base is 15 to 25 feet thick, and the top 12 feet or more; in places the wall is solid and level enough to support an automobile; but in others it consists of massive flights of steps.

The entire eastern section and that at Nankow Pass are built of masonry and bricks and are mostly well preserved; but farther west the wall is much less substantial, has fallen in many places into decay, and in Kansu Province resembles a large mud bank. Certain indications found in the brick work, in legends and in tablets, are that in some parts the towers were built first and then the walls constructed between them.

In many parts of Shensi and Shansi provinces the character of the loess formation is such that it could be cut out into the form of a wall—which plan in reality was very effective. The material was simply split down vertically and then faced with stone. In other places the wall had to be built up of loess, above the plain. A wooden framework was constructed; the loess was thrown in, watered, and rammed; then the framework was removed, leaving the wall fully constructed. Even where built of loess the wall, in spite of long neglect, is generally distinctly traceable between the towers.



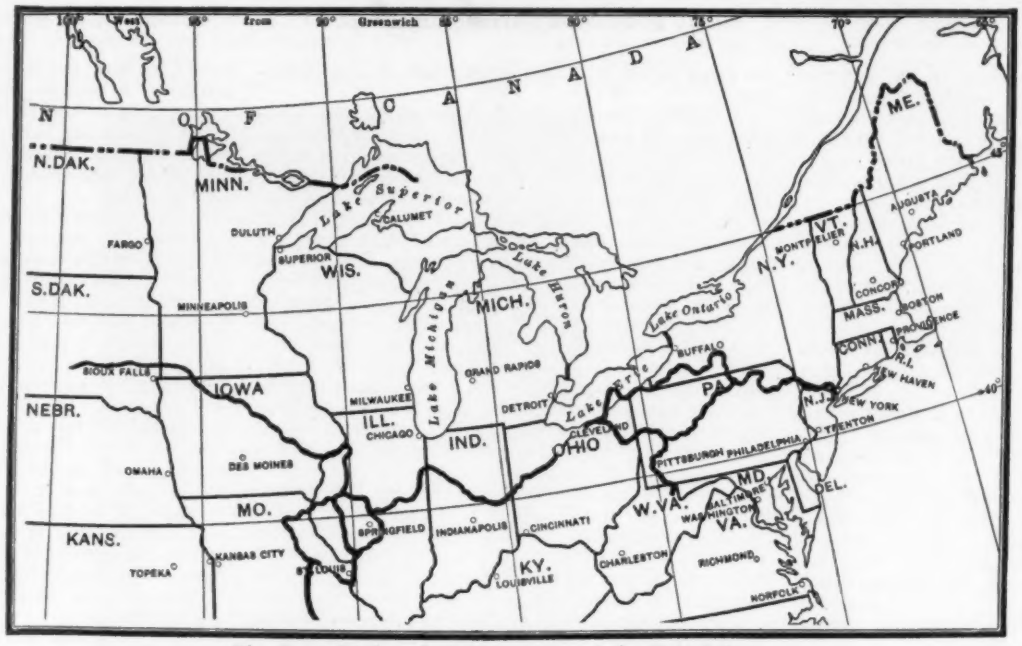
Towers of the "First Frontier Wall" being gradually buried by the sands of the Ordos Desert

The Great Wall at its best can be judged from the section at Nankow Pass, which is in an excellent state of preservation, and is typical of the entire eastern arm. At Nankow Pass, and generally in the mountains, the wall is composed of granite blocks for a height of 20 feet above its base, the blocks being five feet long and one foot square, set in two parallel furrows cut 25 feet apart in the solid rock. The blocks, some as much as 14 feet long by 3 or 4 feet thick, were evidently hauled long distances from the quarries. The upper part of the

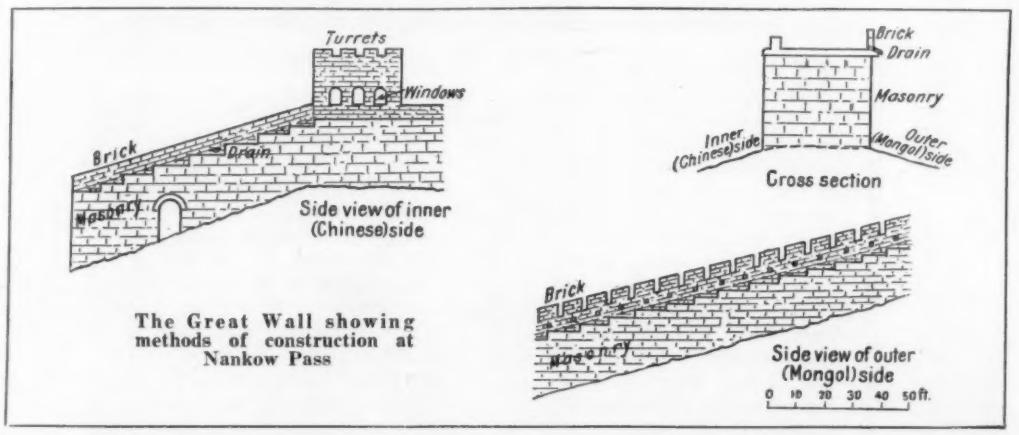
wall is composed of bricks, some as much as 22 inches long, others 14 inches square and 3½ inches thick and of better quality than most brick made at the present day. The mortar that holds the bricks together is better than the Chinese can make at the present time.

At intervals of a few hundred feet are doorways leading to the inner (Chinese) side and steps leading to the top, so that soldiers could easily ascend to defend it against invasion. Every few hundred feet are watchtowers, formerly used as sentry stations, 30 to 40 feet square and 40 feet or so in height. The top of the wall in the Nankow section is a roadway 14 feet wide. At intervals of 50 to 100 feet are stone drains to allow rain water to run off the roadway, and the foresight thus shown has helped its preservation. The engineers who laid out the wall seem to have generally selected strong lines of defense, such as mountain crests and narrow gorges. Huge permanent garrisons were quartered in fortified camps behind the wall.

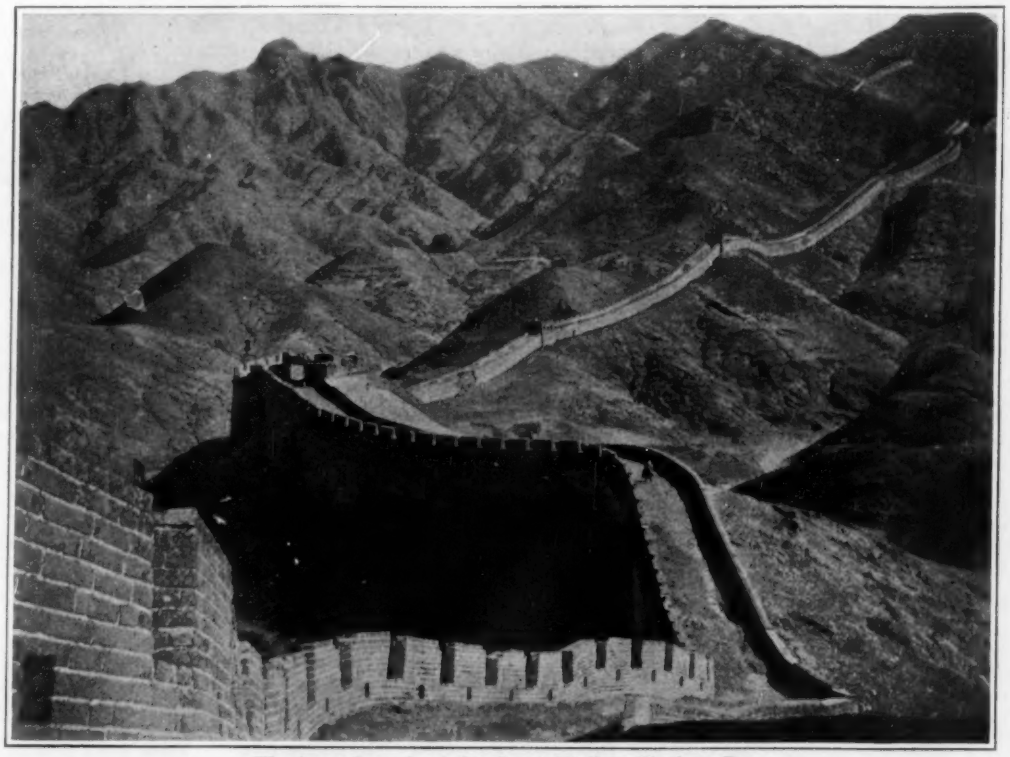
The Great Wall is no longer needed; it has served its purpose. The protection it afforded against Mongol and Hun consisted not only in its substantial masonry or piled loess, but in its wonderful continuity, in the alertness of its defenders, in its system of watchtowers and signals and above all in its expression, concrete and symbolic, as a barrier boundary beyond which no invader could come without incurring the wrath and vengeance of an infuriated people. One foe alone has not been stopped by the Great Wall. This is the sand of the Desert of Gobi that is driven by wind and climatic conditions southward mile after mile, year after year. Owing to the winds and the deforestation of the country, which may be called China's most serious mistake, the desert will continue to move southward and in a few thousand years render even larger portions of Shensi uninhabitable. Is there no remedy for this condition? Mr. Clapp believes there is. A new Great Wall should be constructed, not of brick or stone or earth guarded by soldiers, but a forest barrier guarded by expert foresters. A forest one mile wide along the northern border of the country would probably suffice; in Shensi, at any rate, the project appears to be feasible. Irrigation, too, would reclaim portions of the desert.



The Great Wall projected on a map of the United States



The Great Wall showing methods of construction at Nankow Pass



The inner branch of the Great Wall at Nankow Pass

Vitamine Food Tablets

IN the conservation of food it is necessary to remove the vitamines from certain staple products. Wheat flour cannot be conserved for a long period unless it is bolted, thereby removing all of the vitamines. Cane sugar is perfectly stable, but this stability is due to the fact that any protein or vitamine that may have been in the cane juice has been removed. The hydrogenated fats are about the most stable of the fats, and yet their vitamine content is zero. It is, therefore, highly desirable to have vitamine preparations to add to such preserved foods as these, to complete the diet.

There are many families who do not, under the present system, receive sufficient vitamines in their food. Therefore some addition seems necessary, but this is clearly considered as an addition and not as a substitute for anything. These additions may be in the form of dehydrated products. Many of the vegetables and fruits may be dehydrated and consumed in a form which will furnish the consumer with considerable vitamine, and yet not necessitate a change in the methods of preparation of foods by the family. Those dehydrated vegetables may contain vitamines A and B, and dehydrated fruits may, under certain circumstances, contain in addition some vitamine C. The dietary habits of various persons, however, form an obstacle to the consumption of sufficient vitamines. There are also many persons who can relish fresh foods (spinach, for instance) when they cannot stomach the same foods dried. The peel of citrus fruits, and some other fruits, is very rich in vitamines, yet no one eats them. For those persons who do not relish certain vitamine-containing vegetable products, the use of tablets containing these products, which may be swallowed whole, seems desirable. Orange peelings ground in a meat chopper, dried and ground in a coffee mill, may be made into tablets by the addition of dehydrated orange juice acting as a binder. Such tablets contain vitamines A, B and C. Ground spinach may be similarly made into concentrated vitamine tablets with orange juice.—Notes from an article by Dr. J. F. McClendon in *Science* for October 28, 1921.

Iron for Use in the Manufacture of Car Wheels

THE investigation which has been conducted at the Bureau of Standards for some time past on the stresses in iron and steel car wheels resulting from heating the rim of the wheel has led to some important results. Among other things, it is believed that the performance of these wheels may be further improved by studying thoroughly the metal out of which the wheel is made. In line with this policy, an investigation has been inaugurated to study the relation between the mechanical composition and the physical properties of cast iron of the type used in manufacturing chilled iron wheels. In the preliminary work particular attention is to be paid to the sulfur and phosphorus content of the iron. It is planned to make the iron in a high frequency electric furnace which will permit a very close regulation to any desired composition. It is then expected to conduct the following tests on the cast material: Transverse, tensile, impact, hardness, and wear. The depth of the chill of the chilled specimens will also be noted.

When Tables Tip

The Latest Investigations Into the Externalization of the Psychic Power

By Hereward Carrington, Ph.D.

PSYCHIC research may be defined as the scientific investigation of a mass of apparent phenomena which do not fail under any of the orthodox sciences. These phenomena many of us believe to exist, and hence to form the basis of a new science. In any event, science and its methods may be applied to their investigation, just as to that of any other phenomena.

Before going further, a word of caution is necessary. Because certain facts may be proved, it does not follow that any particular interpretation of these facts is verified. Many European savants are convinced of the reality of so-called "spiritualistic" phenomena, yet they are in no sense spiritualists. The phenomena may be due to unknown powers of the most material sort within our minds and bodies. Let us establish the facts first of all, and apply theories afterwards.

The Editor has already outlined in a signed article the theory, which we must all in some measure accept, that there is a continuous waking self in all of us, capable of manifesting independently of the normal consciousness. And where there at first appears to be no particular relationship between telepathy, apparitions, dreams, crystal-gazing, warnings, mysterious touches, table-tippings, hysteria, genius, unaccounted emotional depressions, automatic writing, etc., etc., yet this theory shows that a connection does exist between them. They are all expressions of the activity of the subconscious mind—the "subliminal consciousness."

Any message arising from the subconscious mind is expressed in symbolic form through some sensory channel. Usually these messages take the form of mere recollection; but if one be imaginative, hysterical, a poet, a genius, a medium, or unbalanced—why then such a message would probably assume the proportions of a psychic phenomenon. It may be visual; it may be auditory; it may express itself in motor form, in which event the subject is unaccountably impelled to some certain action. All these are but expressions of the subconscious message. We do not in these cases assume that a spirit has pointed out the hiding place of the missing papers, or has whispered this knowledge in our ears or engineered the vision of it in the dream or in the crystal ball. We merely assume that the subconscious mind has expressed its hidden knowledge through one or another sensory channel.

When the information conveyed cannot reasonably be supposed to have originated within the subject's own subconsciousness we must seek elsewhere for explanation. If a medium tells you: "Your cousin has just been run over and suffered a broken leg; he is now in Flower Hospital," the question is, assuming this information to be correct, how did the medium's mind come in possession of it?

In a great number of cases, information apparently *has* been given, either with or without a medium, which could not possibly have got into the mind of the medium or into the subconscious mind of the recipient in any normal manner. In the vast majority of cases there is no doubt that it was acquired through telepathy—the transmission of thought direct from one mind to another, without the aid of the senses. As to the precise nature of telepathy there is as yet no certainty. It may or may not be waves that travel from brain to brain. Whatever its ultimate explanation, it is certain that some form of telepathy must exist, and that it is an explanatory hypothesis of great value, enabling us to account for many phenomena for which we should otherwise have no rational explanation.

Thus, when the Society for Psychical Research began its investigations, it was observed that the large majority of apparitions, so-called, coincided with the death of the person represented by the phantasmal figure. Many thousands of cases of this character are recorded. Need we suppose that the "spirit" of the dead man was actually present and manifesting itself at such a time? By no means: the modern theory of telepathy enables us to account for such manifestations in a rational manner, and in conformity with the traditions of science—once the reality of telepathy be granted. For we need only suppose that a telepathic impulse was conveyed to the recipient's mind from the mind of the dying person, and then externalized as a hallucination.

In addition to apparitions of the dying, there are rarer cases of apparitions of the living or of the dead. These latter occur some days, weeks, or even years after the death of the person they represent, and, if they are attached to a certain house or locality, constitute phenomena typical of so-called "haunted houses." Several theories have been advanced to account for these on a subjective basis; and it may even be said that there is a considerable mass of respectable testimony in favor of the view that in certain instances there are involved physical, outstanding entities, more or less corresponding to the popular conception of a ghost, since these phantom forms have apparently moved objects, closed and opened doors, snuffed candles, etc.—and hallucinations cannot do that! But, of course, the vast majority of cases of this character represent mere hallucinations—perhaps entirely subjective, perhaps telepathically induced.

It is impossible to particularize further here in this direction. We must turn our attention now to the physical phenomena of psychic origin—those which affect the material world in which we live, and which may seem to the reader more nearly tangible and intelligible. When we deal with a new force, it is more readily understood than a purely mental phenomenon, since it is more nearly in line with every-day experience. A brief summary of these psychic manifestations will accordingly be attempted in what follows.

WHETHER the skeptic likes it or not, we seem to have pretty definite evidence that the psychic force, whatever its nature, is on occasion able to step out of the subjective realm of hallucinations, mediumistic trances, automatic writing and the like, and actually create material effects in the material world about us. Tables do move; sounds are produced; something which can be felt and photographed and whose continuity can be broken by passing through it is extruded from the medium's person. Leaving behind him the purely subjective and mental phenomena of the psychic which one of the editors discussed in our April issue, Dr. Carrington in the present article takes up these external, objective manifestations. He catalogs them briefly, tells what has been done in the way of scientific investigation, indicates just what progress we have made in the direction of proving their nature and their cause, and puts forward some interesting suggestions for further procedure in this direction. As further progress is made, we shall of course return to the subject of psychic science; but the present article completes the series of which it is a part, and which has been running through our issues of the past six months. We believe we have formulated the present state of this science as well as it can at this time be formulated.—THE EDITOR.

First of all it must be remembered, as before, that when Ouija moves, or tables tip, there can be no doubt at all that in a vast majority of cases the sitters unconsciously push them. So far there is nothing mysterious at all; everything is explained on purely physiological grounds.

But that is not the whole story. In many cases an actual *force* seems to be generated—a force or energy which seems to emanate from the fingers of the sitters, and particularly the medium, and "charge" the table or instrument being employed. When this has taken place the table rises completely from the floor—all four legs—and we witness a complete "levitation." What is the nature of this energy; whence comes it, and how is it applied in order to lift the table in question?

A good deal of study has been devoted to this problem by various psychic students. For our present purposes I shall summarize the investigations and conclusions of W. J. Crawford, a lecturer on mechanical engineering in Belfast, who has had the good fortune to encounter a young, non-professional medium, apparently possessing great power, and to study the phenomena over a number of years by mechanical methods of investigation. This is what he found:

The medium weighed normally about 130 pounds. The table to be lifted weighed about 10 pounds. The medium, chair and all, was placed upon the platform of a weighing machine. Her weight was noted. The seance then began and the table was "levitated." During the levitation, it was found that the medium increased in weight by 10 pounds—that is, the precise weight of the table. This would, of course, have occurred had she lifted it with her hands, in the usual manner, but it was completely demonstrated that no *physical* connection of any sort existed, connecting the medium's body and the table.

Yet the medium increased by the weight of the table! And the table crashed if anyone walked between her and it! Dr. Crawford argued—very rightly, I think—that this shows some sort of *invisible* connection between the two. What was the nature of this connection, and how was it applied?

Dr. Crawford provided himself with a spring balance. When the table was in the air he placed this in turn under all four legs of the table. No pressure was recorded. He then placed it on the floor under the center of the table. No pressure was recorded. When, however, the platform attached to the scale was raised several inches from the floor a sudden pressure was exerted upon it. That is to say, although nothing visible could be detected between the top of the balance platform and the under surface of the table, nevertheless some invisible something now resting upon the balance was supporting the table. And this beam or column was also somehow connected with the body of the medium.

To make a long story short, Dr. Crawford worked out—and conducted a number of ingenious tests which seem to prove—his "cantilever theory" of levitation. It is that there issues from the medium's body a column of energy, which extends outward, under the table, and then rises until it comes into contact with and grips the center of the under surface of the table. It is this which lifts the table. When the platform of the balance is so placed that the lowest point of this invisible column rests upon it, the reaction of the table is naturally supported by the balance, and the weight of the table thus registered. When this is not the case, the weight of the table reacts directly upon the body of the medium, as shown by the scales upon which the medium is seated.

This "psychic arm," for years quite invisible, was finally brought into visibility, in a red light, so that it could be seen, and was even photographed. Crawford goes further. He describes the gradual evolution of a semi-solid substance, from complete invisibility, going on before his eyes—a substance cold, slimy, protoplasmic, and reptilian to the touch. It was undoubtedly *physiological* in nature, but apparently possessed of attributes differing from any normal physiological activities, tissues or organs of the body.

Fortunately, this process of the exudation of a form of "plasma" has been observed in the cases of several other mediums, for a number of years past, and there can hardly remain any doubt that some such extraordinary phenomenon takes place. Dr. von Schrenck-Nötzing, Mme. Bisson and Dr. Geley, particularly, have studied a certain young woman, Eva Carrière, who extrudes or "materializes" this plasmic substance from various parts of her body; and in her case this has not only been seen, touched and photographed, but motion pictures have been taken of the entire process, and a microscopic analysis has been made of certain small portions of the substances which remained behind, after it had receded into the body of the medium! These micro-photographs show us that we are beholding a curious hodge-podge of apparently living matter, thrown together helter-skelter, and more or less resembling a tumor-growth in its peculiarities.

All this in itself is curious enough. But more strange things are to follow! This living substance, which has been seen to issue, visibly, from the medium's body, then begins to take shape, and rapidly forms itself, or is molded, into hands, faces and bits of bodies which last a few moments in vivid life-like reality, and then instantaneously vanish back into the medium's body! These hands have been touched, and it is said that the faces, while they last, are extremely life-like.

These are, I frankly admit, perfectly incredible mani-

(Continued on page 434)

Stretching the Five-Foot Shelf

An Invention That May Reduce the Size of Our Books to a Fraction of Their Present Bulk

By S. R. Winters

VOLUMINOUS periodicals, involving the expenditure of billions of dollars annually in printing and acres and acres of space in which to store, as embodied in the present art of printing may be revolutionized by an invention of Rear Admiral Bradley A. Fiske of Washington, D. C. Labeled as the "Fiske Reading Machine," a patent has been granted the inventor. The device is simplicity and compactness personified, lending itself to easy carriage in one's coat pocket.

The instrument, consisting of a tiny lens and a small roller for operating this eyepiece up and down a vertical column of reading-matter, is a means by which ordinary typewritten copy, when photographically reduced to one-hundredth of the space originally occupied, can be read with quite the facility that the impression of conventional printing type is now revealed to the unaided eye. The device is only six and one-quarter inches long, one and seven-eighths inches wide, one-quarter of an inch thick, and weighs five and one-half ounces.

More about the details of the machine, which consists of four parts: There is an extremely light frame, composed of aluminum. A strip of paper is a carriage for the photographed lettering, which lies in a longitudinal groove in the frame. A tiny lens, capable of magnifying the characters ten times, brings the lettering into prominent review. A roller, really the only mechanical part of the contrivance, serves the purpose of moving the strip of paper along a groove in front of the lens. The forefinger of the hand holding the frame acts in this capacity.

The lettering, reduced ten times just as the lens has a magnification of equal capacity, is imprinted on a narrow strip of paper which may be moved at will in front of the lens at a fixed distance therefrom. These tiny representations or characters are printed from a copper block on which have been photo-engraved, on a reduced scale, common typewritten matter. The process operates in the absence of type and involves no typesetting. However, this novel system renders it possible to photo-engrave books already printed and likewise publish reduced copies at a nominal expense for use in the "Fiske Reading Machine."

Answering frequent inquiries to the effect, "Does the use of this machine tire your eyes," Admiral Fiske likens the effect thus expended to that of reading ordinary lettering with the unaided eye. The characters appear plainly by reason of the lens magnifying them to the same extent that the photographic process reduces them. The structural features of the instrument make it imperative that the characters remain at a uniformly correct distance from the eye. Admiral Fiske, in answering the suggestions of the possibility of the instrument causing jaded eyes, throws out the reminder that engravers toil incessantly at their occupations which is of striking similarity to reading by this machine.

When reading the operator holds the device in front of either eye, propelling the paper in such a manner that it facilitates reading of the representations as is characteristic of reading a book or newspaper. A blinder, attached to the machine, can be operated in obstructing the view of the unused eye. The strain of employing both eyes is thus obviated. Unless the light is dim, one eye is adequate to the needs of reading. The use of both eyes will doubtless involve the construction of a unit of the reading machine more elaborate than the present design.

The dispatch with which one can read when using the "Fiske Reading Machine" is remarkable. At a single glance through the lens one hundred and twenty words are revealed to view. Admiral Fiske, in demonstrating his invention to the writer, read aloud at a rate of 239 words a minute. The writer, in turn, in giving the machine a trial demonstration read, in silence, 287 words a minute by actual count. The strip of paper containing the lettering is chockful of words —10,000 on each side, to be exact. Thus, five such strips, with characters on both sides, would contain 100,000 words, in excess of the number possessed by an ordinary book or magazine. More graphically expressed, perhaps, is the comparison between a package of these strips and the cumbersomeness of a standard dictionary. The latter contains approximately 2,850 pages, weighing about 20 pounds; while 475 strips, two inches wide and nine inches long, could incorporate the contents of a bulky dictionary. The weight of these strips of paper would be only two and a half-pounds or about one-eighth of that of a standard dictionary.

Literally, tons of books are annually published in the United States as reference guides with no object of being read. The "Fiske Reading Machine" would cut the mounting costs of paper and printing involved in this task of magnitude. Similarly, millions of dollars are spent by the Federal government in the publication of bulletins that are never read, and their storage exacts a further toll in the form of valuable space. The invention being described would authorize drastic economies in these instances. Other possibilities outlined in behalf of the "Fiske Reading Machine" were sketched for the writer of this article by the inventor as follows:

1. The cost of manufacturing books, magazines, weeklies and perhaps newspapers will be so reduced that 10,000 copies of one of average size, containing about 100,000 words, can be manufactured and sold to a publisher, for four cents each. If 100,000 copies are issued, they can be sold, of course, at a price much less.

2. Since the best quality of paper must be used, books, magazines and newspapers used in reading machines will last indefinitely. At present, they begin to get discolored and to crumble in a few years.

3. The amount of paper needed for printing any number of words will be diminished to about one-sixtieth of what is needed now.

4. An ordinary book, magazine or weekly as reduced can be sent by mail for one cent, singly.

5. The work of mailing books, magazines and weeklies will be enormously reduced, and the transmission of mail by airplane much facilitated.

6. The space needed for keeping books, magazines and documents will be enormously diminished.

7. The cost of manufacturing magazines, weeklies and newspapers will be so greatly reduced that, in all probability they can be given away; assuming that advertisers will continue to pay as at present.

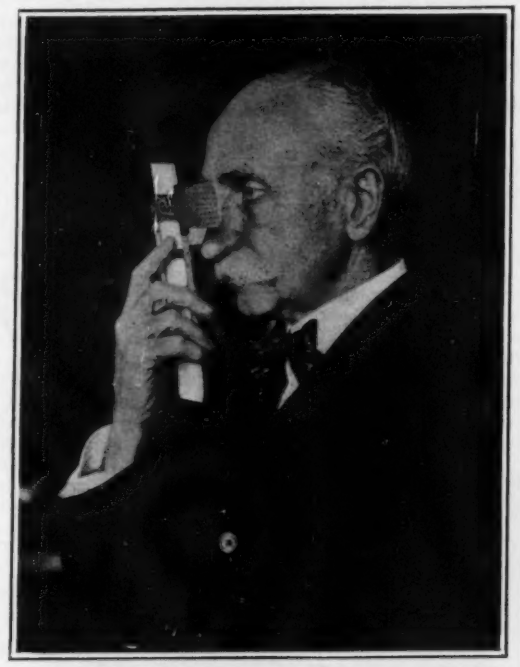
8. Smaller presses will suffice, and therefore less capital will be required.

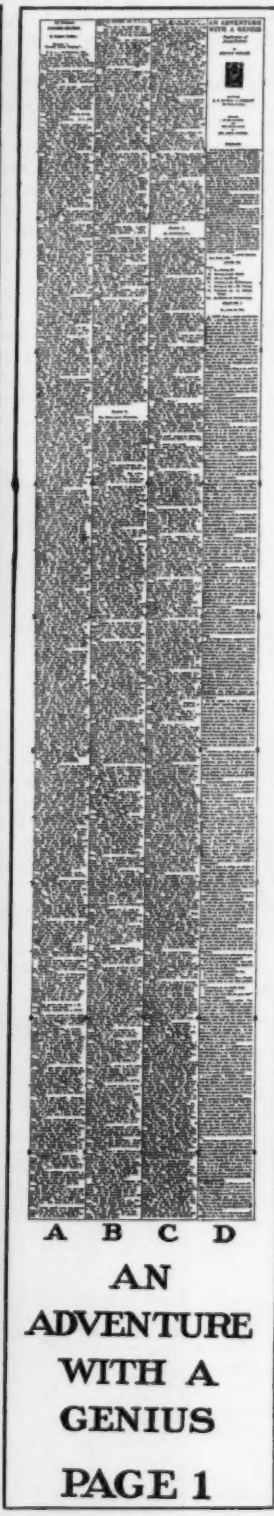
9. Books of reference, such as encyclopedias and dictionaries; standard books like the Bible and the works of Shakespeare and other pre-eminent authors, can be sold for prices much less than their present prices.

10. Eye-glasses and spectacles will not be required for reading.

11. The diffusion of knowledge will be greatly facilitated; because even the poorest people will be able to buy the most instructive and entertaining works.

The "Fiske Reading Machine" is the product of two years of creative effort of the inventor. His original attempt to devise a machine for easy reading is apparently fruitful of achievement. Somewhat of a coincidence, may it not be considered, that this invention of revolutionary possibilities has been introduced at a time when a scientific world is discussing a book, "Invention the Master-Key to Progress," also a product of Rear Admiral Bradley A. Fiske? His creative genius, so wonderfully productive while in the service of the Navy, is not inactive, now that his retirement is a fact.





Above: Rear Admiral Fiske demonstrating his reading machine; the blinder is seen, since only one eye is being used. *Below:* A close view of the reading machine, with strip of reading matter in position. *Right:* A sample page of reading matter, reproduced in its actual size. This page contains 10,000 words, more than 25 times as many as are found on the average book-page

The new technique of reading suggested by Rear Admiral Fiske

Aluminum in German Cars

ONE of the most remarkable features at the recent Berlin Show was the rapidly increasing use of aluminium and aluminium alloys, not only for cylinder pistons and crank cases but for other parts as well, the manufacture of which has become an engineering branch of its own in which some of the late aircraft makers, the Zeppelin works at Staaken among the rest, are taking a leading part. The possibility of using aluminium even for the manufacture of parts submitted to heavy strain mainly depends on the use of an alloy with silicon, raising the coefficient of expansion to a figure close to that of steel and iron. Similarly to the use of armored concrete, some sort of "armored" aluminium, a most resisting and remarkably light material, is now obtained by embedding in the aluminium mass thin steel portions intended to transmit any tensile stresses, whereas the surrounding aluminium is relied upon to deal with compressive stresses.

The Treatment of Fuels by Direct Flame

Coking Coal and Gasifying Liquid Fuels Right in the Fire, Without Danger of Burning Them

By F. Frank

COMBUSTION of fuel is the principal source of energy in almost every industry. The development of this energy is the special task of modern chemistry, the foundation of which was laid by the correct understanding of the phenomenon of combustion.

Any process of combustion requires two substances: one which burns, and one which supports combustion. The latter substance ordinarily is oxygen from the air.

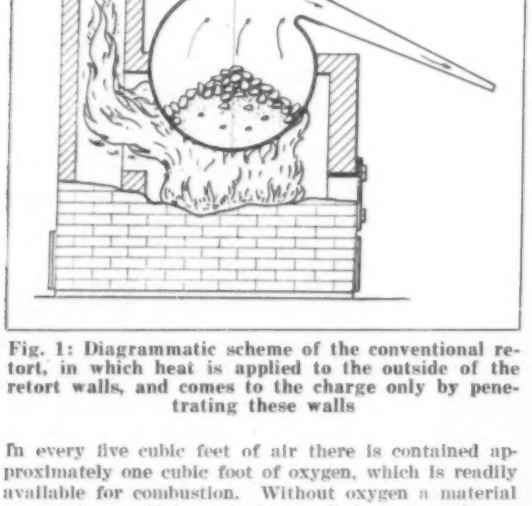


Fig. 1: Diagrammatic scheme of the conventional retort, in which heat is applied to the outside of the retort walls, and comes to the charge only by penetrating these walls

In every five cubic feet of air there is contained approximately one cubic foot of oxygen, which is readily available for combustion. Without oxygen a material cannot burn. Unless air is supplied to an ordinary furnace the fire will go out. The term fire, as used in the industries, describes the burning of fuel under evolution of light and heat. The zone in which this evolution of light and heat takes place is commonly called a flame.

In a retort heated externally in the old-fashioned way (Fig. 1), fuel is burned in the fire-box under the retort in order to heat the material within the retort. The smokestack removes the products of combustion evolved in the fire-box, and draws a continuous supply of fresh air through the fuel bed. The products of combustion carry away through the stack a great deal of heat which must be considered as lost, for it is not employed in heating the material in the retort. The greater this loss, the lower the efficiency of the furnace. The fire heats first the material of which the retort is made, which then transmits part of the heat which it receives from the fire-box to its contained material. Part of the heat evolved in the fire-box is lost through radiation from that portion of the retort not inclosed in the fire-box, and another part is lost through radiation from the walls or brick work of the furnace.

Supposing now that the material contained in the retort is coal and that it is desired to coke this coal by heating it to the temperature necessary to drive off all of its moisture and volatile matter. First, a fire is started under the retort by igniting some fuel and the coal is gradually heated through the walls of the retort. In other words, the walls of the retort form a barrier between the coal and the fire. If this barrier were removed, or even only broken, the coal itself would fall into the flames or be set afire by them. The walls of the retort transmit most of their heat to the nearest layer of coal, and throughout the entire operation this layer of material nearest to the walls will attain a higher temperature than the part of the charge further away from the walls. Long after the nearest layer has been converted from coal into coke the more distant layers will still be coal, and relatively cold. Coke is an insulating material—that is to say, it is not a good conductor of heat. After the first layer of coke has been formed, a condition has been reached where the remaining coal is heated from the outside of the retort through the walls of the retort and through an insulating layer of coke.

The highest efficiency of heat transfer and the greatest utilization of the physico-chemical properties of a flame can be reached only by bringing the material to be heated into direct, actual, intimate contact with the flame. Where the heating of non-burnable materials is involved, the direct application of a flame offers no difficulties. The process of heating combustible and highly inflammable substances, such as coal, petroleum, alcohol, etc., with direct live flames, without setting them afire and burning them, necessitated for its solution years of research work. After many difficult experiments it has been solved in an extremely simple and practical manner.

Fig. 2 illustrates its application to coal contained in an iron retort similar to Fig. 1. The interior firing makes both stack and furnace unnecessary. In order to minimize losses by radiation, the outside of the retort is covered with an insulating material such as asbestos, and the inside is lined with a refractory material, such as fire-brick. The flame in this case is produced by burning fuel gas and air which have been premixed in such proportions that there is present in the mixture just sufficient oxygen to burn the fuel gas. This result is obtained by very simple mechanical mixing devices. The combustible mixture of gas and air is delivered to the burner at such a high velocity that the flame cannot burn back into the delivery pipe. As there is just sufficient oxygen present in the gaseous mixture to support the combustion of the fuel gas, the coal in the retort cannot burn; without oxygen a material cannot burn regardless of the temperature to which it is subjected, even though this temperature be produced by the direct application of a live flame.

The flame temperature can be predetermined and regulated according to the chemical composition of the mixture from which the flame is produced. The character of the flame may be neutral, oxidizing, or reducing, depending upon the desired result. The flame comes into direct, intimate contact with the material, and it can be said that the material itself acts like a breaker in the path of the flame. The flame penetrates, and burns within, the voids of the entire mass of coal, without igniting or burning the coal itself, and without burning the gases and vapors given off by the coal during the heating operation. The flame and the products of combustion fill the voids of the charge and surround each individual chunk of coal from all sides and completely envelop it. The coal is decomposed by the heat into coke and fixed fuel gases and vapors, which, after leaving the retort, are condensed into coal tar. Aside from the advantages already stated, important additional savings are obtained in cutting down the time needed for the heating operation.

When it is desired to gasify completely all volatile matter of the coal as well as all fixed carbon, a furnace is used, into which steam may be introduced, which

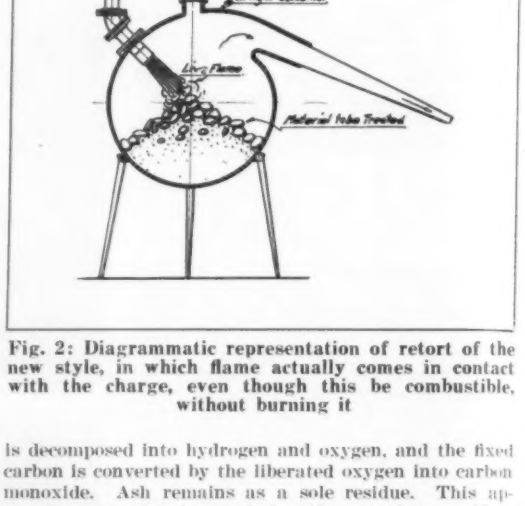
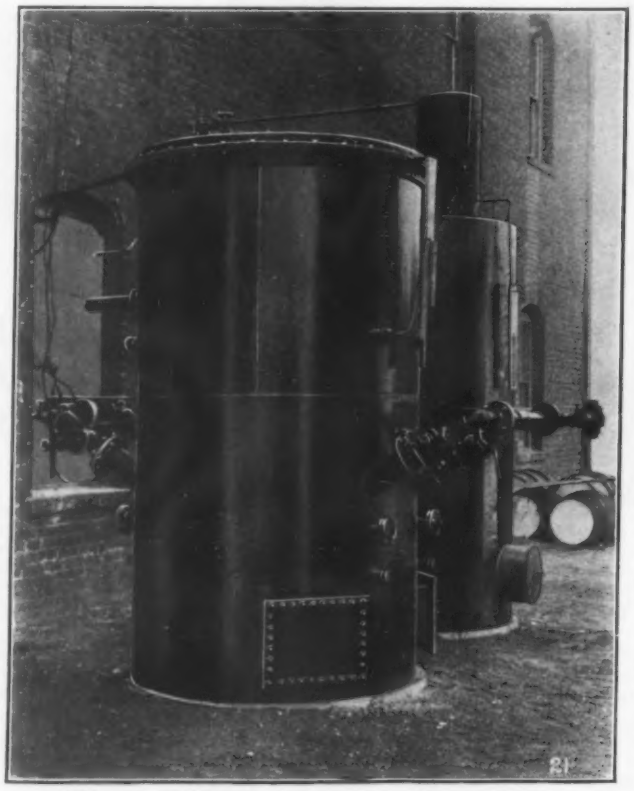


Fig. 2: Diagrammatic representation of retort of the new style, in which flame actually comes in contact with the charge, even though this be combustible, without burning it

is decomposed into hydrogen and oxygen, and the fixed carbon is converted by the liberated oxygen into carbon monoxide. Ash remains as a sole residue. This apparatus can also be used for the complete gasification of solid and liquid fuels at the same time. Coal or coke and oil or tar are fed in continuously, together with steam, and are subjected to the direct action of live flames at their highest calorific intensity. The resulting gas will be a mixture of coal gas, oil gas, and water gas, depending on the relative quantities of solid and liquid fuels used.

The stationary gasification furnace for liquid fuels, in spite of its small size, has delivered in actual operation in the plant at Oakland, Calif., at the rate of over 200,000 cubic feet of fuel gas per hour made from ordinary fuel oil and steam. Live flames play directly upon a refractory bed of broken fire-brick and form flame screens through which atomized oil and steam are drawn. The atomized oil in practice is completely vaporized before it reaches the flame zone, and is decomposed therein into fixed fuel gases and residual carbon, which in turn is subjected to a vigorous water-gas reaction with the steam. The labor cost in connection with this furnace is negligible. Gas has been made by this new process from about the same amount of oil as is required by many eastern coal-gas plants for the mere purpose of carburetting or enriching the coal gas. This gas is suitable for city distribution, as it possesses all properties required for heating and illuminating purposes. It has the added advantage that it does not contain naphthalene or sulfur compounds. The sulfur in the oil is converted into sulfur dioxide, which is absorbed by the water in the scrubber. The chemical analysis of the gas shows a nitrogen content which in certain cases may be as high as 50 per cent, without, however, lowering the fuel value of the gas.

The reactions, which are set up between steam and oil vapors at the high temperatures prevailing in the flame screens are not yet definitely understood; and adequate means for the correct chemical identification and analysis of the components of gas made at these high temperatures have not been developed to establish a basis for the comparison of the fuel gases made by this and other processes. For practical purposes the chemical analysis of a fixed gas is immaterial as long as the gas is of the desired heat value. It is foreseen that a considerable discussion among chemists will arise over this question.



Stationary gasification furnace of the internal type for liquid fuels

The Heavens in June, 1922

The Recent Reports of Shifting Latitudes, and What the Astronomer Makes of Them

By Prof. Henry Norris Russell, Ph.D.

ONE of the most interesting of recent astronomical investigations—told at the meeting of the American Astronomical Society last December, but not yet published in full—deals with the apparently unattractive topic of measurement of latitude.

Everyone knows that the latitude of an observer—whether on a ship at sea or at a fixed observatory—is determined by observations of stars. If we could find a star which passed directly overhead (through our zenith), our latitude—or roughly, our distance from the equator on the earth—would be equal to this star's declination, or distance in degrees from equator in the heavens. Any other star will do if we can find how far it is from the zenith when it crosses the meridian, and if we know how far it is from the celestial equator.

Until about 30 years ago it was believed that the latitude of any point of observation, fixed on the earth's surface, was always the same. But as observations became more precise, it was found that there was actually a slight *variation in latitude*—amounting to but a few tenths of a second in all, but unquestionably real. This was first noticed in Germany, and confirmed shortly afterwards by observations in Hawaii by an expedition sent for the purpose. These showed that when the latitude of the European station increased that of the Hawaiian post decreased, and hence that the earth's pole was moving, rather than either station. Before long the problem was fully solved, mainly by the labors of the American Chandler, who found that the motion of the pole could be represented as follows:

How the Pole Behaves

Starting with the average position of the pole—a fixed point—we may imagine another point moving about this in a circle, at a distance of about 15 feet, and with a period of 14 months, while a second point moves about the first moving point in an elongated ellipse once a year, never getting more than about 12 feet from it. This second point gives the position of the "instantaneous pole"—that is, the spot on the earth's surface about which it turns on any given day. The combination of these two influences may change the distance of an observer from the pole by as much as 25 feet each way, producing a variation in latitude of about half a second of arc. Both terms in the motion were promptly explained theoretically—the 14-month term arising from a natural tendency of the spheroidal planet to wobble a little, and the annual term coming from changes in the ocean currents, etc., with the seasons. The latter term, in particular, is not quite the same from year to year; and it became evident that, if the full value of modern instruments was to be realized, it would be necessary to keep track of its amount by special observations.

An international arrangement was therefore made, by which five observatories were set up on the parallel of 39° 8′ north latitude, and observations of the latitude were made on every clear night with zenith telescopes—instruments especially designed to give results of the highest attainable accuracy. One of these stations was in Sardinia, the next, counting eastward, in Turkestan, the third in Japan, the fourth at Ukiah, Calif., and the fifth at Gaithersburg, Md. Among them they encircle the pole on all sides, so that it cannot move in any direction without approaching at least one of them, and receding from some other; hence its drift is doubly checked.

Some 20 years' work at these stations has made it possible to follow the periodic motions of the pole with great accuracy. But all this is an old story: the new part follows. It was noted a few years ago that, in addition to the periodic fluctuations, the latitude of Ukiah showed a steady tendency to increase. A plot of the average values derived from the observations of one year after another (when corrected for the periodic changes) showed that the effect was unquestionably real—a steady shift of about 0.01″ per year, and corresponding to an approach to the pole at the rate of one foot annually. Certain geologists suggested that this might mean that this part of California was really moving northward—perhaps as a part of one of those great movements of the earth's crust which end in slipping along lines of fracture, and thus cause great earthquakes like that of 1906. Ukiah is many miles from the particular fault-line along which the motion then occurred; but the suggestion was of great interest.

It has been carefully tested by Dr. Lambert of the United States Coast and Geodetic Survey, whose conclusions are those referred to at the beginning of the present paper. Dr. Lambert confirms the increase in the latitude of Ukiah, but finds that a similar increase, at an almost equal rate, appears in Maryland—where it certainly cannot be attributed to the California earthquake! Moreover, a similar northward drift is found in Europe and in Turkestan, while the Japanese station shows no change at all.

The Latest Puzzle

This looks queer at first sight. On the average, *all* the stations seem to be moving northward! The north pole cannot be moving toward them all at once. Is it possible that the earth is bulging out in the north, and its whole surface moving slowly in that direction? By no means, the physicist would answer—at least, by no means at present known to science. Fortunately, we do not have to invoke any such wild explanation. The observed facts, reduced to their simplest terms, mean that, whereas the stars which are observed for latitude used to pass through certain definite points near the zenith, as seen from these stations 20 years ago, they now pass slightly but perceptibly to the south of these positions. This means either that the zenith (from which the positions are measured) has moved northward—or that the stars have moved southward. Now the stars on the observing list are actually in slow motion in the heavens, like all the other stars; but these "proper motions" have been allowed for in working out the observations. Before we can allow for them, however, we must measure them; and this can be done only by comparing modern observations with observations made many years ago (often a century). These older observations were not as accurate as can be made nowadays, and it may be that they were all, on the average, a little wrong. In this case the calculations based on them will fail to allow sufficiently for the slow southward average motion of the stars in the heavens; they will gradually shift to the southward of their calculated positions and the calculated latitudes will come out too far to the north.

We may therefore substitute for the improbable hypothesis of the bulging of the earth the very probable one that the old observations of the stars were slightly in error. The correction to the proper motions which would remove the discrepancy is only about 0.005″ per year, and for the most other purposes could be forgotten entirely.

But when this correction has been made, certain small shifts in the latitude of the various stations remain. The European observatories show practically no change; but the American stations indicate a northward drift though at only one-half the rate previously suspected, while the Japanese station is moving southward at about the same rate.

This set of changes can be explained by a real motion of the north pole in the direction of the American continent, which would take it away from Japan, and hardly change its distance from Europe at all. From a careful discussion of the observations Dr. Lambert finds that the pole, during the last 20 years, has been moving toward 77° west longitude at the rate of 0.005″ per annum, or six inches a year on the earth's surface. This motion is, of course, in addition to the periodic changes described earlier. The 20 years of observation make its reality very probable, though not yet certain; but another decade or two will settle the question.

If this motion of the pole continued indefinitely, it would amount to about eight miles in a million years. Of course, we have no way at all of telling whether it has been uniform in the past, or will be in the future, or whether it alters its rate and direction from century to century.

It is perhaps worth pointing out explicitly that the motion indicated by observation will not do anything to explain the great Pleistocene glaciation of North America. This was probably in full swing far less than a million years ago, when the pole, if moving in the manner indicated, was only a couple of miles from its present location.

At 11 o'clock: June 7.
At 10½ o'clock: June 14.
At 10 o'clock: June 22.

At 9 o'clock: July 7.
At 8½ o'clock: July 14.
At 8 o'clock: July 22.

At 9½ o'clock: June 30.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on June 7, etc.

NIGHT SKY: JUNE AND JULY

The Planets

Mercury is in conjunction with the sun on the 18th, and is visible only at the beginning of the month, just after sunset, or at its close, in the dawn.

Venus is an evening star in Gemini and Cancer, very far north, and correspondingly conspicuous. Though not yet at her greatest elongation, she remains in prominent sight until 9:30 P. M. or later.

Mars is in opposition on the 10th, and is nearer and brighter than for a dozen years. His closest approach to the earth comes on the 18th, at a distance of a little over 42 million miles. Unfortunately for northern observers, he is in declination 26 degrees south, and reaches an altitude of only 24 degrees on the meridian of New York. This necessitates one's looking through twice as much air as would be in the way if the planet were higher in the sky. Even with a small telescope, however, the principal surface markings may be seen if the air is steady.

Jupiter and Saturn are in Virgo, about 7 degrees apart, and are conspicuous from the twilight hours well on in the night. Uranus is in quadrature on the 4th, west of the sun in Aquarius, and observable in the morning. Neptune is in Cancer and is observable until about 10 P. M. in the middle of the month.

The moon is in her first quarter at 1 P. M. on the 2nd, full at 11 A. M. on the 9th, in her last quarter at 7 A. M. on the 17th, and new at 11 P. M. on the 24th. She is nearest the earth on the 3rd, farthest off on the 16th, and in perigee again on the 28th. During the month she passes near Saturn on the 3rd, Jupiter on the 4th, Mars on the 9th, Uranus on the 16th, Mercury on the 24th, Venus and Neptune on the 27th, and Saturn again on the morning of July 1.

The Inside of the Question

"What Is the Matter with Our Colleges, and What Are They Going to Do About It?"

By Dean Ellery of Union College

GRANT, for the sake of argument, that Mr. Edison's criticisms of the American college undergraduate and of the American college, as reported in this journal in the November issue, are based on fact. They are not based on fact, but we will assume for the moment that they are; for even then, it is easy to show how unjustified they are. For example, he complains that when the colleges graduate young men with a grade of 60, they are sending out into the world youngsters who have been right only 60 per cent of the time, and he states that no industry wants that kind of a man—one who is right only 60 per cent of the time. The answer to that is easy. The college undergraduate during all of his four years is constantly breaking new intellectual ground; he is meeting new subjects of thought; he is forming new mental concepts; he is exercising a new set of mental "muscles." Under those conditions mistakes are inevitable. We do not remember how many tumbles we got when we first attempted to walk; without help we should have tumbled more. The finished pianist and violinist probably do not recall with how great labor they ran their first scale and how many errors they made in the performance of their first piece. Mr. Edison himself was probably right a good deal less than 60 per cent of the time when he first began work upon an incandescent electric light. So, even if it were true that the numerical grades given to the college undergraduate represent the percentage of time that he is right; since he is constantly at work in fields which for him are new fields, if he is right 60 per cent of the time, he is a pretty good worker.

There is no basis of comparison between the undergraduate and most men in professional or business life. The man who is right all the time in life is likely to be the one who is doing one single thing in an office or a factory, who is meeting one set of conditions to which experience has accustomed him. He may be the man who is turning out day after day one small part of a complicated machine; he may be a clerk who gathers and distributes stereotyped business information; he may be a so-called official who makes quotations upon the basis of a carefully worked-out scheme of costs; or he may even be a still higher executive who is "directing" the activities of men in set and definite channels. The number of men at the top of industrial organizations who are responsible for the successful conduct of work under new and always changing conditions is just as small, relatively, as the number of college boys who rank high in their classes, and the reason is the same in both cases.

We could safely leave the argument here, but it was all made on an assumption: that the grade of 60 in the work of a college course represents the fact that that individual was right 60 per cent of the time. It represents nothing of the sort, or, rather, it represents a good deal more. These arithmetical grades given throughout the educational system, while apparently representing either the percentage of correct information which the student possesses or the number of times he has succeeded in the total number of efforts made, actually show where that individual stands in the scale of intelligence. It is a comparative figure; it shows the relative position of undergraduates. It means that there are some undergraduates who are highly intelligent, quick to learn, exact in their work, correct in their conclusions, indefatigable in their labor. There are others who are not so gifted. If there were no colleges at all, there would still be the same grades among individuals. Any circles of life will show the same relative conditions in men who have never been in college. What A and B and C and D, or 60 and 70 and 80 and 90 mean in a college life is nothing different from what $1000 a year or $2000 a year or $5000 a year or $10,000 a year mean in a life outside of college.

Yet, there is a need to answer directly the questions at the head of this paper, which are taken from the reported interview with Mr. Edison in the November SCIENTIFIC AMERICAN. There *are* certain faults in the process of college training which, if corrected, would enable the colleges to do even better work than they are doing now. When the question, "What Are the Colleges Going to Do About It?" is aimed at these faults, every college officer is thoughtful, for he knows that criticisms based upon actual fact must be met seriously. The process of training which the college affords is now handicapped by two things: large numbers of students, and small numbers of experienced teachers. The first means large classes of instruction, so large that individual contact of mind with mind is almost impossible; the other means that when these large classes are divided into small instructional sections, there are not enough experienced teachers to go round.

The large class is a menace to the output of a very fine product. That is universally true where anything other than a mechanical process is involved. A good cook may make a delicious pie. Delicacy may still be present if he makes two pies. At some point delicacy is inversely proportional to the number made at one time. Mark Hopkins and one student is still the ideal college; Mark Hopkins and ten students might produce good results; but Mark Hopkins and fifty students would result in poorer product. There is a limit to the extent to which a man's personality and mentality can reach under a single set of conditions. We may hope for a day when there will be no classes in our colleges larger than ten or a dozen students.

If the colleges are fortunate enough to be able to divide large classes into small sections, the quality of the work done will be improved in all those sections when each is in charge of experienced and successful teachers. The freshman year and the senior year are relatively more important than the sophomore and junior year, and of these two, the freshman year is more important than the senior. In that period the boy must get accustomed to the larger freedom that comes when the restrictions of home are released. He begins to be controlled from within rather than from without. He learns to assume the responsibility of making his own choices. It is the period when the boy needs the strongest, the most intelligent and the finest pedagogy. The full professor of the colleges who asks to be given advanced students only and to be released from the monotony of teaching freshmen does not appreciate the fine opportunity that is his. I cannot say what the colleges are going to do about it, but I can say that when the college can have small instructional sections, and when it will bring its freshmen into immediate contact with its best, strongest and finest men, there will be an improvement in its products. The good men who are products of the present process will be better men, and there will be more of them.

MR. EDISON has had his say, and what he has said has been sufficiently uncomplimentary to our colleges and the men whom they are turning out. Several correspondents have written at considerable length in reply to his remarks that appeared in our November issue; but most of them were too busy attacking his theory that a memory test will result in the selection of men of executive ability to pay any attention to what he said about the colleges. Dean Ellery, however, whose portrait is shown, from long experience with the colleges and their problems naturally was more interested in this side of the inventor's views as reported by a member of our editorial staff. We think he makes a very good case, and are glad indeed to give him the space in which to make it.—THE EDITOR.

The Age of the Earth

AT the meeting of the British Association in Edinburgh in September last a joint discussion on the age of the earth took place under the auspices of the sections for Mathematics, Geology, Zoology and Botany. The inadequacy of Lord Kelvin's original estimate of twenty or thirty million years has long been admitted. The more recent estimates are for a much greater age.

Lord Rayleigh considered that the most accurate estimate of the age of the earth can be derived from the rate of radio-active disintegration. Uranium passes through a series of successive stages during its disintegration which terminate in an isotope of lead, having an atomic weight less than that of "ordinary" lead, but chemically indistinguishable from it. The order and rate of this disintegration through successive stages are known with a high degree of accuracy, so that a determination of the amount of the isotope of lead present in minerals containing uranium enables the time when disintegration commenced to be assigned without very great uncertainty. In this way an age of about 1,000 million years is derived from pre-Cambrian rocks.

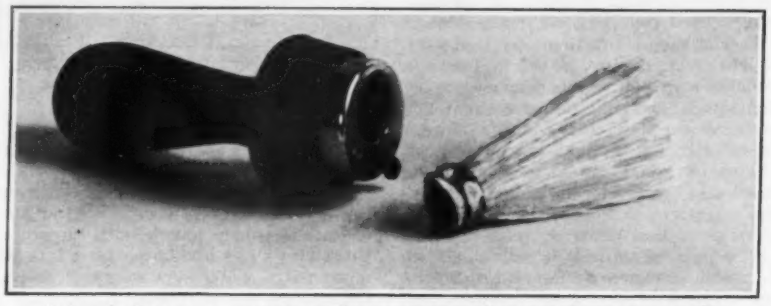
Professor Gregory dealt with the geological estimate of the age of the earth, based upon the salinity of the sea. Estimates obtained in this way varied from 70 to 150 million years. He pointed out that the argument suffered from three fundamental objections. It was assumed that the sea was originally fresh, although the oldest fauna, the Cambrian, had marine characteristics, and the contrast between the fresh water and marine fauna in Palaeozoic times was as sharp as it is today. There was also no allowance for the large supplies of sodium chloride raised from beneath the earth's surface by magmatic waters. Further, a uniform rate of denudation was postulated, whereas there have been alternating periods of quick and slow crustal movements: the earth is now under the influence of a time of quick movement, with consequently, denudation faster than the average. Taking these three causes separately, Professor Gregory estimated that, to allow for them, the age of the earth deduced from the salinity argument should be multiplied two-fold, three or four-fold and five-fold respectively. He concluded by stating that the best known geological estimates of the age of the earth requires to be multiplied ten or twenty-fold in order to agree with the physical estimates, and that this increase is consistent with the geological evidence.

Dr. Jeffreys stated that, from considerations of the temperature distribution downwards in the earth's crust, allowing for the radio-active content, and also from the tidal theory of the origin of the solar system, he had separately devised concordant estimates of about 2,000 million years since the solidification of the earth's crust. Thus with revised data, two of Lord Kelvin's methods of reasoning have been brought into agreement with the results derived from other physical methods. Lord Kelvin's third method—the contraction hypothesis—is not valid on account of the existence of other sources of stellar energy.

It will have been gathered that, on the whole, there is now a satisfactory agreement between the results of arguments based upon astronomical, physical and geological considerations. These indicate an age of the earth, since solidification, of 1,000 million years.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



A brush for every customer, thrown away after use, is made possible by this arrangement

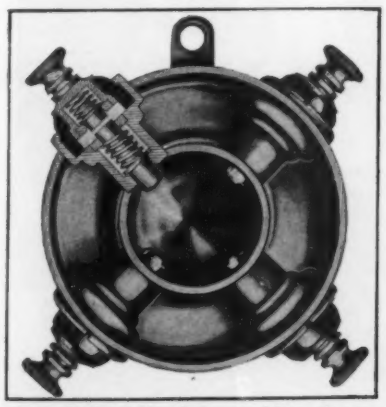
The Sanitary Shaving Brush

SANITARY requirements enforced upon barber shops and similar establishments these days are pretty severe, and it is not always a simple matter to know just how to proceed with the business of shaving, manicuring, massaging, etc., in accordance with the demands of the public health authorities. One of the problems revolves about the shaving brush. We all know the extent to which the deadly anthrax germ lurks in this, and anthrax is only one of its possibilities. Sterilization of the brush after each usage is easy to say; but it is less easy to do, less easy still to keep an eye on the individual barbers and see that they do it—and it costs money. Nor is it of much avail to sterilize brushes in a puddle of dirty water, such as is sometimes seen in use for washing glasses at a carelessly conducted soda fountain.

The inventor has come to the rescue of the barber in this predicament, and has provided a brush that is used only once, and then thrown away. A little tuft of sisal fiber constitutes the business end of the brush, and it is clipped into the handle and used. Then it is released and a fresh tuft substituted; and instead of being more or less cleaned for reuse, the used brush-end is thrown out. The principle of the safety razor, in other words, is applied to the brush. One handle, many blades, has been a familiar situation for some years; and now we shall have one handle for many brushes.

Simplicity in Hose Clamps

RADIATOR hose clamps are one of the banes of automobiling. Most of us have struggled with screw-driver and pliers, trying to hold the one end while we turned the other, to loosen a recalcitrant clamp; and most of us have been stranded with an old clamp that has just been removed, that is hardly fit for service again, and for which we have no substitute. A clamp that works without a screw sounds good, at first thought, until the awful thought comes that if it has no screw it certainly must have a spring. But we illustrate a clamp that has neither screw nor spring—unless one insists upon the technicality that the clamp itself is a spring. It works by means of little "adjustment slots," the edges of which are raised sufficiently to catch and hold the pawl, against the spring-action of the clamp itself, when one pawl is pressed into engagement. It has five of these slots, giving a range of three eight-inch sizes. The lever that works the pawl is operated with one finger, and the clamp can be attached in a fraction of the time ordinarily required.



The shell of the hammer-blow timer, with one post broken away to show the mechanism

The hose clamp that works without screw or spring

The Hammer-Blow Timer

EVERYBODY who has ever driven the universal popular-priced car for any distance knows that its weak spot is the timer. Every garage mechanic has his favorite replacement timer, which he advocates and puts on if permitted, and which usually does give better service than the one that came with the car. Of these replacement timers, some give their better service through the use of better materials. These are nice enough to have on your flivver, but they do not make an interesting story. Occasionally we find one that bases its claim to superiority on a different mode of operation; and then we have a story to tell. One of this kind is illustrated herewith.

The trouble with the standard timer for the flivver is that the brush and the contact posts make a wiping contact while the brush is in rapid rotation. After a few million turns it is self-evident that the contact surfaces are going to get worn, that contact will be less clean, and that the spark will accordingly be less efficient—if, indeed, it is not now and again jumped entirely. The timer we illustrate differs from the usual type in that there is no current at the point of wiping contact. The roller acts not as an electrical member at all, but simply as a cam. It strikes one post after the other as it rotates, and drives each down, against the pressure of a spring, to make a hammer-blow contact at the gap shown in the illustration. It is clear enough that the roller itself, and the post against which it delivers its pressure, may become so seriously worn that they would utterly fail to function electrically, and yet the shock of contact would remain sufficient to drive the floating hammer home and make the necessary electrical connection at the gap.

A Screw-Driver for an Emergency

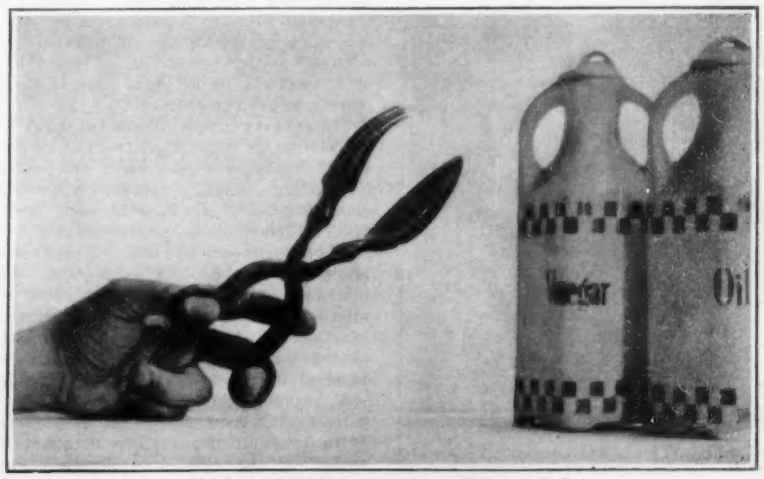
ONE of New York's prominent citizens was recently locked, with his wife and eight servants, in his air-tight

Some details of the arrangement by which the live axle may be removed through the hub

wine cellar, which has a combination lock. In the pitch darkness he managed to break off the blade of his pocket knife and, using the stub as a screw-driver, to remove the combination plate of the lock from the inside of the vault door, releasing the party just about in time to avoid serious respiration difficulty. The tale is told merely to demonstrate that one never knows when one may need a screw-driver. A thin-edged washer, carried in the vest pocket, is the latest idea for an emergency screw-driver, and will usually do the work unless the screw is too firmly set.

A Double-Duty Table-Tool

A DOUBLE advantage is to be gained by using this device, invented for the purpose of mixing salads. In the first place, the housewife always has the necessary fork and spoon united so that the spoon can be used for measuring, the fork for stirring, and the combination for lifting the lettuce up and down in the bowl. Another advantage is that they are made of horn, doing away with rust and corrosion of metal from the vinegar and salt used in the salads.



Knife and fork in one for mixing salads

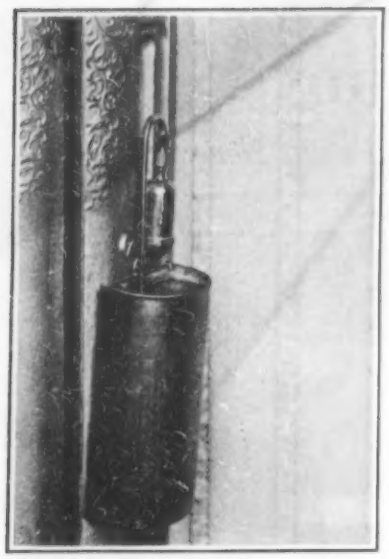
A pocket screw-driver for use in a hurry

An Innovation in Axles

A LIVE axle that can be removed through the hub-hole of the wheel, without removing the wheel or even jacking up the car, is claimed in U. S. patent No. 1,274,559, issued to Mr. J. B. Ketchum of Hampshire, Ill. Mr. Ketchum supplies us with a photograph of an axle constructed according to this idea, showing the essential features by means of which it may be removed by simply removing the hub cap. The latter is bolted to the wheel hub by the same six bolts that hold the spokes in place. This hub can be fitted with any style bearings.

Weight of Steel Rails and Their Life

THAT the weight of a steel rail is an important factor in the life of the rail but in an entirely different way than might be expected has been established by the experience of one large Eastern railroad. In the last few years the road referred to has gradually replaced



A muffler for the radiator—combined with a humidifier

its 80-lb. rails with 105-lb. rails. A careful record of the life of the heavier rails compared with that of the lighter ones has brought out the rather astonishing fact that the 105-lb. rail lasted in the regular road bed 2.7 times longer than the 85-lb. rail did with very little change in chemical composition. In other words, the addition of 25 pounds to the yard has increased the life of the rail 270 per cent.

But the ratio of increased life is not the same above or below these figures. It has been found that the 130-lb. rail lasts only 40 per cent longer than a 100-lb. rail while a rail of the 80-lb. class lasts only about twice as long as the 60-lb. rail.

In 1910, the country's rail production was 12.18 per cent of the total finished steel output; in 1913 it was 14.12 per cent. But in 1919 and 1920 rail production was 8.77 per cent and 8.05 per cent respectively of that of finished steel. This wide difference, it is claimed, is not due altogether to railroad control nor to lack of funds or similar causes. It is the conclusion of the railroad referred to that the extensive adoption by the leading large railroads of the country of the 105-lb. rail, with its much longer life, has been a strong determining factor.

Beating Eggs by Faucet Power

IN the top of this mason jar cover is a small water motor. When the water is turned on very slightly the beating device within the jar starts action. Motor and top of jar are made in unit, to fit any standard glass jar. An adapter is provided for the faucet that does not have threads. Egg-beating device screws on much as does the garden hose.

Simple water-motor for beating eggs

Noiseless Steam Radiators

THIS device combines a steam radiator valve silencer and a humidifier. The long tube is screwed over the valve in place of the regular cap, and when properly adjusted takes the noise away. The pan of water needs replenishing every three days. Any leaking runs into the pan and prevents water from running on the floors.

Cutting Fluids

MACHINISTS have long recognized lard oil as well nigh indispensable in certain cutting operations, though for the majority of machine-shop work much cheaper oils may be used to advantage. The reasons for the superiority of lard oil have not been clearly understood, but they turn out to be closely related to the general theory of lubrication; and with the development of fast-moving machines this theory is of vast economic importance.

The purposes of cutting fluids are to cool the work, lubricate, lessen wear, insure a good finish with accurate dimensions, wash away chips and prevent the formation of dust. The materials used may be classified as oils, air, water and aqueous solutions, and emulsions. For mere cooling water, with its high specific heat, is ideal. But it tends to rust the machines; so, while used to some extent, it usually has added to it soda, sodium silicate, sodium resinate, or other alkaline substances. Moreover, in difficult cutting operations the chip is apt to "seize" the tool, causing dullness of the tool, roughness of the work, etc. Hence it is inferred that in such cases water is out of place, and some actual lubricant is required.

Oils may be of animal, fish, vegetable, or mineral origin, or compounded of two or more of these. The edible animal oils are too expensive for use as lubricants; hence only the inferior grades are thus utilized. Fish oils are objectionable unless deodorized; vegetable oils tend to gum; and mineral oils are low in adhesion and therefore poor lubricants. Compound oils are largely used, containing a large percentage of mineral oil with a smaller percentage of vegetable or animal oil, or of both. Air is used merely to remove chips.

The experiments of Tower led many to the erroneous belief that two oils of the same viscosity would have the same lubricating value. Consequently the cheaper mineral oils have in many cases been looked upon as equivalent in every respect to the fatty oils. There are, however, certain operations in the machine shop, such as the threading of micrometer screws, threading and tapping wrought iron, parting off mild steel, boring gun barrels, etc., in which no mineral oil, regardless of its viscosity, will produce the excellent results obtained with lard and other fixed oils. With lard oil the surface obtained is smoother, the chip less serrated and longer, the tool of longer life, the production increased, heating minimized, and the machine found to run more steadily.

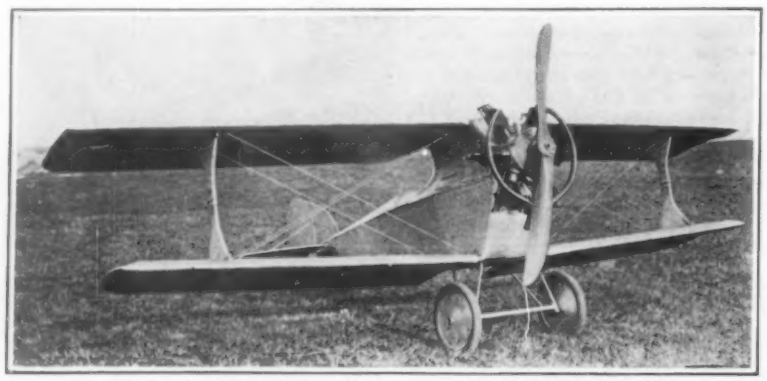
It appears that whenever two *clean* surfaces of metal are brought together they tend to seize. Many examples prove that a quite invisible layer of impurity will prevent seizure. The clean metal of the chip moving over the face of the tool under great pressure affords a peculiarly difficult problem in lubrication. Lard oil has a much higher *adhesion* for metal than do the pure mineral oils. It is drawn in between the chip and the tool and forms a strong film which prevents the chip from adhering to the tool and forming a "bead." Other oils containing fatty acids, or groups of atoms with "residual affinities," such as sperm oil, castor oil, rape oil, etc., have in large measure the advantage of lard oil.

The whole subject is discussed at length in Technologic Paper No. 204 of the Bureau of Standards, prepared by Eugene C. Bingham. It seems readily possible to improve mineral oils as cutting fluids and as lubricants by adding liquids of high adhesion such as oleic acid, pine oils and fixed oils. Methods are suggested for the measurement of adhesion. The Deeley friction testing machine and the Lanchester worm-gear machine, developed in Great Britain recently, demonstrate the superiority of the fixed oils as lubricants, and the advantage of adding them, or their acids, to mineral oils intended for lubrication.

Emulsions have the advantage of cheapness while possessing much better lubricating properties than the aqueous solutions. Mineral oil compounded with neutralized sulfonated oil will form a permanent emulsion when mixed with various proportions of water. Mineral oils are compounded with an alcoholic solution of soap. A third variant is marketed as a paste, it being a thick soap solution, plus mineral oil. The second type is the most desirable and the third is the least so.

As to the choice of a cutting fluid for a given operation, the character of the operation performed has more to do with the choice of cutting fluid than the character of the metal. For drilling, reaming, milling, planing and sawing emulsions are generally satisfactory. For tapping and threading and parting off, compound oils and lard oil are often resorted to. Compound oils are used with automatic screw-cutting machines.

The material cut is, however, not without some bearing upon the problem. There is a general consensus of opinion that soft steel and wrought iron are difficult metals on which to get a good surface without lard or sperm oils. They are called "draggy" metals. Cast iron, on the other hand, being brittle, does not adhere to the tool and no lubricant is required. Contrariwise, on a hard, brittle steel, lard oil merely produces a "glaze," and turpentine is used with success.



All-metal plane of French design, with detachable wings

The wire grid cuts the slab of butter into 48 pieces at one operation

A Rapid Butter-Server

A POUND of butter placed in this apparatus may be cut into forty-eight segments at one stroke Press down on the brick of butter with one hand and operate the metal handle with the other. Crosswise wires divide the mass into its many parts, while the cutter underneath determines the thickness.

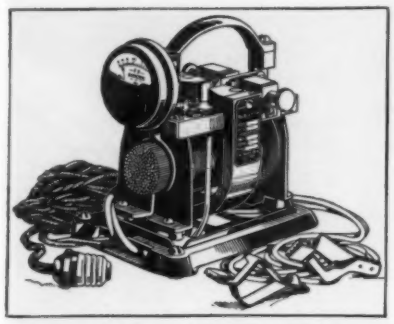
The Vest-Pocket Airplane

DEVELOPMENT of the all-metal plane is taking a curious direction in France; and we may shortly expect to have announcements of the plane that can be carried under the arm. We illustrate a step toward this goal—a metal plane with detachable wings, which it is claimed can be taken off or put on again in two minutes. The tested speed of the machine is 120 kilometers—about 70 miles—per hour.

Something Different from the Jack

WE illustrate a simple little contrivance, invented by Mr. Lynn Beadle of Detroit, which is intended to do away with the automobile jack. It is a light but strong bridge of cast steel, which is screwed into two holes bored for the purpose in the felloe of the wheel. The car is then driven ahead or back a few feet until the no-jack bridge comes down and the wheel rises on it. A tire may then be removed and replaced, chains put on, etc. With this device the wheel can be lifted into place for easy tire-changing in seven seconds. The attachment also serves as a spare-tire guard, and as a mud-hook or sand-hook for driving over heavy roads. The difficulty of burrowing into a mess of mud that rises high about the tire to find a place of support for the jack is altogether a thing of the past with this handy little apparatus which solves this problem automatically.

The substitute for the jack that uses the car's own power to raise it



Storage battery recharger which may be used with the usual alternating current lighting circuit

A Storage-Battery Recharger for the Home or Garage

EVERY so often it becomes necessary to recharge the automobile storage battery by some external means. This is particularly true when the automobile has been standing idle for a long period and the battery is discharged to a point where it will not start up the engine. Again, since the widespread introduction of radio receiving sets, especially of the vacuum tube type, which requires a storage battery, a recharger is virtually indispensable unless one is willing to send the storage battery to a recharging station every ten days or two weeks, with the trouble and great expense which such procedure involves.

The present storage battery recharger, shown in the accompanying drawing, is of the vibrating type for use on alternating current circuits. Its vibrating member, supported between the pole pieces of powerful electro-magnets, rectifies each half of the alternating current cycle so that direct current is obtained, after the transformer member of the recharger has already stepped down the alternating current voltage to the low potential required for recharging purposes. The ammeter indicates the output of rectified current which is available for the storage battery connected to the recharger by means of the flexible leads and the clips.

The recharger in question can be used anywhere. Indeed, it is provided with a handle so that it can readily be carried about from place to place, and connected with any alternating current source by means of the attachment plug and cord.

For radio purposes the little recharger is ideal. The author of these lines has employed one of these rechargers with satisfactory results. The 6-volt 6-ampere-hour storage battery delivers current for approximately 20 operating hours to a vacuum tube detector and two-stage amplifier, after which it must be recharged. The recharging station fee is generally $1.00. By means of the little recharger, however, the same battery can be recharged in about 18 to 20 hours at a cost of 12 to 15 cents, according to the writer's experience. This cost is based on current at 15 cents per kilowatt hour. The recharging rate for such a battery with this recharger is 5 to 6 amperes.

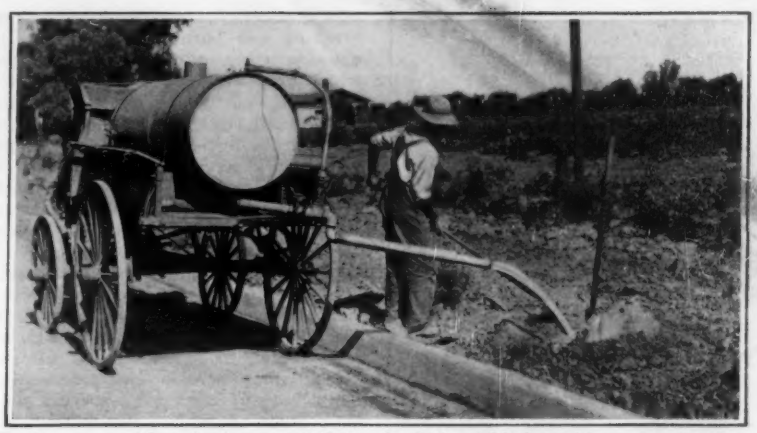
Motive Power from Sewerage Gas by a Unique Method

AMONG the many suggestions for developing motive power, probably none is more unusual nor unique than that of using sewerage gas. A British engineer, however, now seriously advocates this.

After recalling that the project was by no means new, having been used more than 25 years ago, with a septic tank for lighting sewerage works, the lecturer proceeded to relate some of his own experiences and investigations. He had visited the Matunga Leper Asylum at Bombay early in 1920, and had seen there a small engine which had been driven on this medium as far back as 1907. This in itself indicated the practicability of the scheme; but more recent work carried out at Parramatta, Australia, under "aerobic" conditions had finally decided him to try the potentialities of sewerage gas in a colder and more changeable climate.

An opportunity had been found at Cole Hall Sewerage Farm, Birmingham, where a suction-gas plant had been adapted at slight expense. The plant consisted of a 34 h.p. horizontal engine, a 5-in. centrifugal sludge pump, a small well, a sludge-digestion tank, and a gas-holder. Previously the obtainable sludge had been very watery, and contained no more than 3 per cent of solid matter; but a denser material, containing about 10 per cent, would shortly be conveyed by a new main. Even with the more volatile liquid, however, considerable success had been achieved in deriving sufficient power to work the pump. At Cole Hall most of the sludge was bought by farmers for manure, and only the amount necessary for the power plant would be subjected to fermentation.

There remained the question of economy to be considered, and evidence on this subject pointed to the value of sewerage-gas operation over a suction-gas plant. It had already been determined that a gas-production of 25,000 cubic feet from four tons of solid matter was obtainable at the Cole Hall Farm, and this amounted to a gasification of 18 per cent.

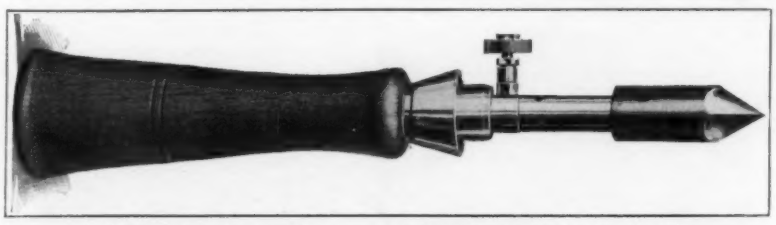


Tank wagon with swinging spout that solved the ticklish problem of irrigating the young shade-trees along a California highway

Irrigating the Row of Trees Along a Road

CITIZENS of Glendale, California, recently undertook the beautifying of a five-mile stretch of motor highway between that city and Eagle Rock. A part of this plan called for the cultivation of rows of live oak trees along the sides of the highway. In a region where rainfall is abundant all the year, producing such an avenue of trees would be very simple, but in southern California we have a long arid season, when young trees will die if not carefully watered. After the live oaks have attained sufficient growth to acquire deep rooting they will take care of themselves and thrive through the dry summer.

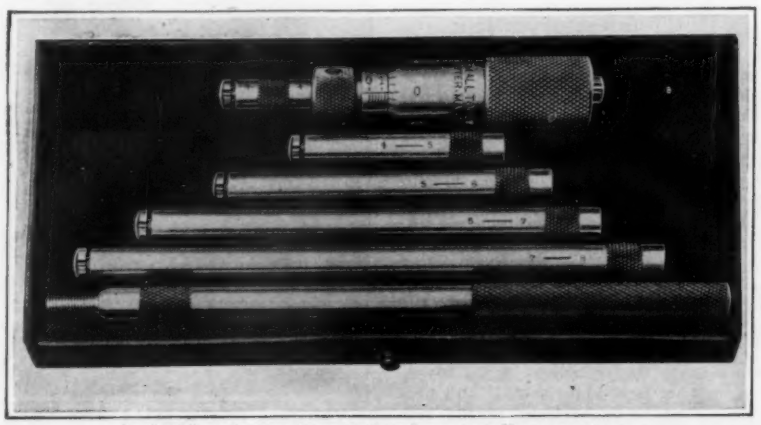
Irrigating the five-mile lines of young trees on either side of the highway presented a problem seldom encountered in irrigation, but not to be defeated in its purpose, the city caused to be built a rather novel tank wagon with a swinging water spout. With this wagon, shown in the accompanying photograph, the gardener drives along the avenue. After filling the tank wagon he drives from tree to tree, watering each one, and carefully cultivating the soil about the tiny trunks. This method of watering the trees has not only been found thoroughly successful, but the work is accomplished with a minimum of labor.



This soldering iron contains an alcohol blow torch in the handle

An Improved Inside Micrometer

THE inside micrometer calipers is a tool to which attention has not been given in proportion to its intrinsic importance. We illustrate a newly marketed and greatly improved outfit which is intended to remedy this lack. In the construction of barrel, spindle and thimble the regulation diameter of these parts as found in the usual outside micrometer is used, affording a much sturdier tool and one more suited for use in garages and repair shops, and permitting larger figures on the scale. The handle is detachable, and in such a way that the tool can be instantly changed from right-hand to left-hand use, so as always to present the scale for easiest reading. Interchangeability of the various rods is promoted; it is necessary only to unscrew the rod from the threaded stud at the end of the barrel. These rods are interchanged by simply unscrewing from the threaded stud at the end of the barrel. Each is internally threaded and ground square at the hardened end, which sets squarely against the barrel shoulder, while the rod at point of measurement is fitted with a hardened tool steel anvil which can be adjusted to lengthen the rod and compensate for any anvil wear resulting from constant use. The anvil faces are ground on a comparatively small radius, making the micrometer especially adaptable for measuring parallel or curved surfaces.



An inside micrometer set that is unusually easy to use

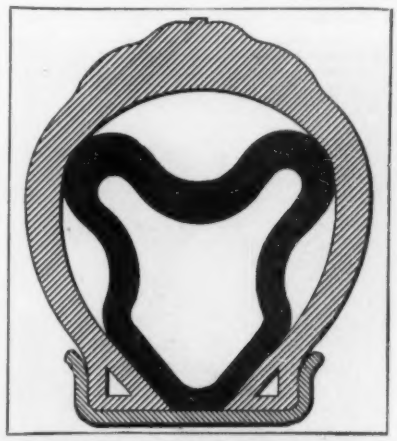
A Soldering Iron That Contains Its Own Blow Torch

BY having a blow torch form part of a soldering iron there has recently been developed a soldering iron that may be used anywhere with all the convenience that has heretofore been such a powerful argument in favor of the electric soldering iron.

The new soldering iron, which is shown in the accompanying illustration, contains an alcohol blow torch. The reservoir of the blow torch is inclosed by the handle; a brass filling cap, which is reached by removing the end cap of the handle, gives access to the reservoir for refilling. The blow torch is started by pouring alcohol or gasoline into the cup member about the base of the soldering iron stem. When this primary charge is ignited it heats and vaporizes the alcohol, and gives a hot blow torch flame which is directed against the base of the soldering copper. A needle valve controls the flame. The soldering copper may be removed so that the blow torch may be used alone.

The Tube That Repairs Its Own Punctures

WE illustrate about as ingenious an attack as we have yet seen upon the eternal problem of the puncture-



Cross section of the compression inner tube, showing it uninflated. When filled with air, the wall is under severe compression and tends to close a puncture at once

The safety chuck for drills—the drill cannot break when overloaded because the soft pin shears off first

proof tube. The inventor tells us that rubber will flow, if we give it half a chance, and fill a puncture. He accordingly makes his tube with a circumference considerably greater than the inner surface of the casing for which it is designed. The extra rubber is taken care of, and it is made possible to insert the uninflated tube inside the shoe, by deep corrugations that are molded around the tube, as indicated in our diagram, which shows the uninflated tube in position in the casing. When it is now inflated, and forced by its contained air to conform to the shape of the casing, a pressure is set up along its outer wall which is claimed to be sufficient to close the hole made by any ordinary puncture, and keep it closed. The "compression tube" is made in Tulsa, Okla., and has been in rather extensive use in the southwest, with very good results.

Removes Skins and Seeds Quickly

A SCIENTIFIC fruit and vegetable press has been designed which shortens work, saves food and improves the flavor. Apple sauce is made with the *skins on*, then removed with this rotary press. It improves the flavor, so authorities tell us. The wooden roller can be given a good scrubbing after use. By the removal of all skins on vegetables, stomach doctors tell us, much irritation to this organ is reduced.

High-Speed Drilling Without Breakage

QUICK-CHANGE drill chucks for drills with taper shanks are nothing new, but the makers of the one illustrated herewith believe they have in it something that is new. This chuck has a safety device which prevents drills, taps, reamers, counterbores, etc., from breaking and burning. The device in question consists of a soft steel pin which drives the collet without a hitch ordinarily, but which shears off when the cutting tool is overloaded. The sheared pin is then removed by simply loosening a screw, and a new pin inserted in its place. Soft pins are altogether cheaper than hard, shaped and edged or pointed cutting tools. And aside from this direct economy, it is claimed that steel can be drilled at a rate of 5 to 7 inches per minute when the operator knows that he cannot harm the tool; and cast iron at 10 to 14 inches per minute. In drilling at this rate two strong chips develop and force themselves out of the hole, carrying with them much of the heat generated.

A press for seeding and paring fruit and vegetables

A German "Stunt" for Saving Gas

ONE of our German correspondents shows us a rather clever use of an ordinary heating coil in conjunction with a gas stove. Two holes, one above the other, are pierced in the outer member of a double boiler or similar vessel; the two ends of the coil are inserted, and the coil itself arranged so that when it is set over the gas burner it takes an advantageous position with reference to the flame. The coil is filled with water at the outset, and as much water put in the double-boiler base as is considered desirable; the natural circulation of the water which takes place with heating, and which makes the ordinary kitchen boiler and the thermo-siphon system of automobile cooling effective, at once gets in its work, and that is all there is to it. The single gas flame can in this manner be made to serve three purposes—it will cook something set immediately over it, cook the contents of the vessel to which the coil leads, and heat the water in this vessel and in the coil for any use which it may be possible to make of it after the cooking is done.

An efficient heating coil for use with a gas-stove

Transmission of Electricity from Norway to Denmark

THE question of transmitting electricity from the Norwegian waterfalls to Denmark is now well under way, a committee of official representatives for Denmark, Norway and Sweden being at present engaged in establishing a definite scheme. In fact, inasmuch as the possibility of carrying electric power from Norway across Western Sweden as far as Gothenburg, and thence by submarine cable to Denmark, had for some time been under discussion, Sweden obviously is likewise interested in the scheme. However, the Danish representative, Prof. Wm. Rung, has just worked out a new plan by which electricity is to be transmitted by a submarine cable from Norway immediately to Jutland. Any difficulties at first encountered in this connection have been overcome by using direct in the place of alternating current. The cost of the scheme is estimated at 40 million kroner, covering the cable to be laid through the Skagerrak, the erection of two large receiver stations at Vendyssel and Kolding respectively, and the installation of high tension lines destined to carry electricity to Jutland, as far southward as the German frontier. Zealand and Funen, on the other hand, will by means of the cable already installed in the Sund be supplied with Swedish electricity, which even at present is transmitted to northern Zealand.

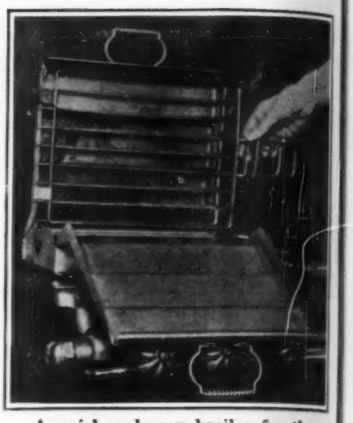
An Electro-Magnetically Operated Violin

ENDEAVORS have long been made to set up permanent vibrations in the strings of musical instruments by electromagnetical means. While an electromagnet arranged close to a string will attract this on receiving a current impulse, in order again to release it as the current ceases, this process only results in harping of the string, thus being a mere equivalent of striking or pulling it with the finger.

According to German press notices, Dr. Otto Schaefer, of Hamburg, has, for the first time, succeeded in designing an attachment which receives a number of current impulses corresponding to a number of vibrations of the string. The sound produced by pressing down a key is said to have a surprising effect, being soft and full, free from any secondary noises and comparable with the softest string registers of an organ. Some difficulties experienced in carrying out his idea, Dr. Schaefer only overcame after many years' assiduous work.

A point of especial importance and which shows the great superiority of the new instrument as compared with organs, is the fact that in addition to a pedal, alternating the intensity of all the sounds struck at a time, the strength with which each key is depressed will control the strength of the corresponding sound. In fact, the sound is said to obey the slightest pressure of the finger even to the point of allowing a *vibrato* to be produced. The melody can, accordingly, not only be set off from the accompanying voices, but can be brought out with the whole charm of swelling and waning sounds.

The inventor has so far been able to demonstrate the principle of his invention only on individual sounds and harmonies, but looks forward to the construction of an entire instrument.



A quick-and-easy broiler for the modern kitchenette

A New Way to Cook

MEATS are placed on this vertical grid and shut up inside the broiler, placed over a fire and in a very short time steak, chicken, fish, etc., can be broiled on *both sides* without turning. A pan in the bottom catches the juice.

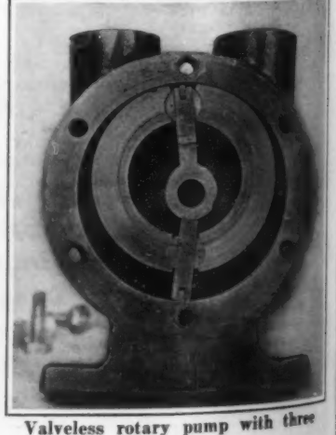
Shingles of Copper

SHINGLES of copper is one of the products being specialized in since the war. A large American company has put on the market copper shingles in three sizes: 6 by 18 inches, 8 by 18 inches and 8 by 60 inches, all weighing approximately 84 pounds to the square of 100 feet. The roof of a large church in Brooklyn, N. Y., is to be covered with such shingles which are regarded as probably the lightest substantial roofing material.

The weight of copper shingles compares with 200 pounds to a square of 100 feet for the wooden shingles, 400 to 600 pounds for asbestos, 750 to 1200 pounds for slate and 1000 to 2000 pounds for tile.

Rotary Pump of Extreme Simplicity

A ROTARY pump with but three moving parts, no valves and no packing, is the claim made for the apparatus of which a sectional view is given herewith. It comes to our attention as the result of a recent test at Houston, Texas, during which a three-inch model lifted water 29½ feet and pumped at 100 pounds pressure, in both cases being driven by a motor of only one-half horsepower. In addition to its availability as a pump, the device also ran as a steam turbine at 6600 revolutions per minute. The pump, which is the invention of L. F. Smith of Houston, is claimed to be suitable for pumping anything from water to the thickest of Mexican crudes.



Valveless rotary pump with three moving parts

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Pigments in Australia

AN investigation of the geological formations in Queensland has shown that large deposits of valuable oxides and ochers exist near Sooktown, especially in the vicinity of Cape Flattery. A sample of Indian red, obtained from that region was analyzed and found to contain almost 50 per cent more iron oxide than the ordinary pigment; one-third as much alumina and no carbonate of lime. It is stated in the official report that if the latter constituent is required, it can easily be supplied from neighboring coral reefs.

Wax from Sugar Cane

ACCORDING to the *Oil, Paint and Drug Reporter*, January 16, 1922, a wax is obtained from sugar cane, which resembles carnauba wax very much. The cane itself contains about 1 per cent of this wax, which is found principally in the rind. In the sugar refining process this wax is removed in the filter cakes, and the latter have been known to contain as much as 10 per cent of this substance. It is possible to extract the wax by means of benzine, and there are certain isolated plants which are today carrying out this process. The crude wax is hard and brown, and looks much like beeswax, but when it is purified, a product is secured which not only resembles carnauba wax closely, but which can be used to good advantage as a substitute therefor.

Gasification of Coal Dust

WHAT to do with coal dust has been a difficult question which has received much attention from chemists and technologists. Burning it in the furnace, briquetting it in admixture with tarry products have been suggested and processes and apparatus have been devised and are now in use for carrying out these suggestions. Recently, the gas manufacturers in Germany have been experimenting with coal dust in the manufacture of gas. In *Chemiker Zeitung*, 1921, pages 789 to 790, there appeared an article on this subject, in which details of the operating method and of the apparatus used are given. Briefly, the process consists in atomizing the coal dust with superheated steam and then passing the mixture over highly heated bodies. In this way the coal dust is subjected to a distillation process, and there are recovered the various products usually obtained in the destructive distillation of coal. Coke dust is formed as well and this reacts with the superheated steam to form water gas. The process is continuous and possesses the advantage of total consumption of all the ingredients of the coal, as the coke that might be recovered in such a process would possess but little or no value, due to its granular condition.

New Fertilizer and Insecticide

ACCORDING to the French publication, *La Revue des Produits Chimiques* (reprint in the *American Gas Journal*, January 14, 1922), the spent purifying mixture, recovered from gas works and originally containing slacked lime and ferrous sulfate, can be used to good advantage as a fertilizer and insecticide. The purpose of this purifying mass is to remove ammoniacal and cyanogen compounds from illuminating gas, and when the potency of this material for this purpose is exhausted, the mass contains about 7 per cent nitrogen.

As there is contained in this spent material a certain amount of sulfocyanides and ferrocyanides it may be used advantageously as an insecticide and weed killer. In this fresh condition it must not be used after the plants have commenced to grow, as it will destroy all vegetation, but if it is strewn over the ground before the plants come up, it will positively kill all growths of weeds and injurious insects, and by the time that the plants have come up out of the ground its poisonous character will have disappeared and its properties changed into that of a fertilizer. In order to be able to use it first hand as a fertilizer, it is necessary to age it. The aging process serves to convert the sulfocyanides and ferrocyanides into ammoniacal products. Careful tests made with the material have corroborated the claims made for it.

Rubber Latex in Paper Making

THE rubber latex, in the condition in which it is tapped from the tree, that is, in the non-coagulated form, is used in admixture with paper pulp in the beater to form a rubber-paper, which is said to possess remarkable properties. While the process may not be practical, it is very interesting and has been patented in England, and is a reflection of the strenuous efforts that are being made at the present time to find new outlets for the superabundance of rubber in the world. The process consists in adding the latex to the extent of 0.5 to 5 per cent of the paper stock to the pulp beater. After a thorough mixture has been obtained, a coagulating agent is added, such as acetic acid or mineral salts, which converts the latex mixed with the paper fiber into a gel. The paper-making process is then carried out in the ordinary manner, and the dried paper can be vulcanized by the cold vulcanization process. The product is a paper of high strength and considerable resistance to shearing. It is claimed that a very good grade of paper can be made in this manner from very poor quality pulp. For further details the reader is referred to British Patent No. 167,935.

Ammonia from Sugar Refinery Refuse

ACCORDING to the French magazine, *L'Engrais*, November 15, 1921, a sugar refinery in France has undertaken to manufacture ammonia from the nitrogen found in molasses and vinasse, which are recovered in the process of refining sugar. It is estimated that if all the molasses produced in France were treated by this process about 17,000 tons of ammonium sulfate would be produced yearly.

Viscose Silk with Artificial Resins

ARTIFICIAL silk is made from viscose, or rather one type of artificial silk is known as viscose silk. In dyeing this sort of material, it has always been difficult to obtain fine dark shades. Another difficulty has been the tendency of the silk to be affected by water. According to a recent discovery made by E. Bronner of Mulhouse, France (see British Patent No. 171,125), the artificial resin that is obtained in treating phenol with formaldehyde is added to the viscose before spinning and preferably before ripening. The addition of the artificial resin has the effect of making the silk threads take darker shades in the dye bath. It also enables them to resist more effectively the action of water.

Borax in Photography

THE action of borax in photography is very paradoxical, as in certain cases when added to the developer it serves to accelerate its action, and in other cases it has a retarding effect. This is explained by the fact that while borax will give a decided alkaline reaction when dissolved in water alone, still when added to a caustic soda solution it will decrease the alkalinity of the same. Hence, when it is added to such a developer as hydroquinone, containing caustic soda, the alkalinity is reduced and the developing action of the reagent is retarded. Other substances such as bicarbonate of soda and sodium phosphate will do the same thing. Borax has been recommended as an addition to developers in order to produce a diminished grain in the picture. (See December 31st number of *Chemical Trade Journal*.)

Fertilizer from Blast-Furnace Gas

PLANTS need carbon dioxide to grow. The air contains this gas to the extent of about 0.03 per cent. When this proportion is increased as in the air in green-houses, the plants were found to grow much more rapidly, but the cost of producing the additional carbon dioxide gas is out of proportion with the results obtained. According to *Canadian Chemistry and Metallurgy*, January, 1922, experiments have been made in Germany in using the waste gas of blast furnaces for this purpose. The success obtained therewith was so great that special nurseries have been established in connection with the plants of the Deutsch-Luxembourg Company and the carbon dioxide gas is pumped directly from the steel plant to the green-houses and sown fields of the nursery. The result has been an increase in plant substance amounting to from 50 to 300 per cent, according to the nature of the plant treated. It is estimated that the gases obtained from the consumption of 1100 tons of coke in the smelting of 1000 tons of pig iron are sufficient to produce 4000 extra tons of edible plant material. If all the gases were used in this manner from an average yearly production of 15 million tons of pig iron in Germany, then the extra yield of food materials would far exceed the present crops.

Aluminum Varnish

IT is well known that a coating of aluminum will protect iron against the action of high temperatures. Many processes have been devised for applying this coating, but they all require the use of special apparatus and exact technical knowledge for their application. During the course of an investigation into the distillation of coal for by-product yield, it occurred to the investigators, according to *Brennstoff Chemie*, 1921, page 343, to attempt to obtain such a coating by using aluminum powder mixed with ordinary rosin varnish. The varnish was made by dissolving one part of rosin in five parts of benzol, and enough commercial aluminum powder was added to give a mass of the proper consistency. The iron parts that were to be coated with this preparation were first carefully cleaned and filed smooth, painted with varnish and then subjected to a temperature of about 750 degrees Centigrade. The organic matter burnt off and the aluminum remained behind on the iron in the form of an absolutely homogeneous, uniform coating, which afforded ample protection against high temperatures. This process can be used by anyone and does not require any technical skill to obtain the correct results. It is not advisable to use pure aluminum powder, but the commercial product, as that contains a little zinc which has a very beneficial effect.

Utilization of Cotton Stalks

EVERY year there are vast quantities of cotton stalks, burnt up or disposed of in other fashion, in this country and other cotton-growing lands. The utilization of these stalks has been discussed in an article, appearing in the *Bulletin of the Imperial Institute*. The investigation has shown that the stalks form a promising material for paper making, and that they might be used as well for obtaining acetic acid, tar and charcoal by a process of dry distillation.

New Petroleum Products

PETROLEUM has been occupying the public eye recently in view of official governmental reports regarding the depletion of supply, which, it is claimed, is now in sight. J. H. James, in *Chemical and Metallurgical Engineering*, 1922, 209, does not appear perturbed by this announcement, but has gone ahead and developed some new uses for petroleum by modification of the distillates, obtained therefrom, to yield oxidation products of particular value. The oxidation is brought about by the proper choice of temperature and with the assistance of catalysts. The products represent all stages of oxidation from alcohols to oxygenated acids. The acidic portion of the oxidation product was separated and treated with caustic soda. The result was a hard resinous mass. The suggestion is made that these resinous substances may be used as cheap varnish gum and paint film substitutes.

The possibility of developing a new fuel from the cheaper fractions of petroleum is also presented by carrying out the oxidation at higher temperatures. Gas oil or residues from cracking stills can be oxidized in this manner, and because of the tendency of the oxidized products to decompose thermally and yield substances having a lower molecular weight, which are therefore more volatile, low boiling point mixtures can be obtained which lie within the gasoline range. It is also hinted that the heavier fractions of these oxidized oils may perhaps find use in the lubrication of internal combustion engines. The oxidized oil can also find application in the field of oil flotation.

Radium in Czecho-Slovakia

ACCORDING to the Commerce Reports the uranium ores, which are found at Jachymov in Bohemia, contain large quantities of radium. The known supply will last 20 years at the present rate of production. About two grams of radium are produced each year. Steps have been taken to modernize the present plant and increase the output of the mines.

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

A Protest from New Bedford

To the Editor of the SCIENTIFIC AMERICAN:

In your January issue of the SCIENTIFIC AMERICAN, on page 39, appears the following sentences:

"The chief difficulty with incineration is that the fumes from the burning garbage are likely to create a public nuisance. The City of New Bedford, Mass., recently had an experience of this sort. New Bedford, until recently, disposed of its garbage by reduction, but when the plant began losing large sums of money, an attempt was made to economize by installing a dryer so that garbage could be burned under the digester tank boilers. The fumes inspired such a protest from citizens that the plan was quickly abandoned."

This statement is incorrect, inasmuch that since the dryer has been installed no odors have emanated from the garbage plant. We have been using the chlorine process of disinfection.

Very truly yours,
CHARLES S. ASHLEY, Mayor.

New Bedford, Mass.

Our Vanishing Forests

To the Editor of the SCIENTIFIC AMERICAN:

Your editorial entitled "Every Man for Himself," published in your August 6th, 1921, issue and relating to reforestation, was interesting reading to all lovers of the woods and especially to those of us who spend our vacations in a forested State of our Union, the Maine woods.

My observation of the timber in this land is that the trees reforest themselves if destructive man with his axe and torch gives them half a chance. For instance, within a mile of this resort (Kineo) there is a lumber camp which is operated primarily for the purpose of getting out white birch for spool wood, but the cutters also take all standing timber that is worth while which comes in their path. The spruce and fir are wanted for pulp, the pine and hemlock for lumber, the cedar for shingles and railroad ties, the black and yellow birch and maple for furniture and veneers. Now, when this section of land has been stripped of its noble forest growth there springs up at once a thick underbrush of mainly cherry. The cherry, say the lumbermen, does not grow to any size in Northern Maine, but seems to act as a cover growth of timber which follows—the usual Maine woods forest of spruce, fir, pine, cedar, hemlock—and the birches—some maple and beech.

Nature in its own way has started a forest which may be of value in 100 years, and it is stated that on this very tract of land which is now being scalped of its marketable timber, the present fine stand of white birch is due to the fact that about 100 years ago a devastating fire swept over this region destroying everything burnable in its path. So apparently the Maine woods will reforest themselves—if, as said, man will give them a chance. But there lies the danger—will they get a chance with inroads that are being made from modern demands? It is certainly pathetic to see splendid spruces of over 100 years of age stricken by the saw and axe, only to be ground into wood pulp for the consumption of newsprint. Splendid forests are turned into yellow journals or papers that the world would be better off if never printed. Therefore one of the greatest blessings that could come to forest preservation would be to find a new base for paper and stop utilizing noble forest trees for such a base purpose. The SCIENTIFIC AMERICAN has published a number of articles on other means of supplying paper and pulp, but in the meantime spruce and fir is the paper base with all the laborious operations and destructive consequences. Maine, which was once a great lumber State, is now, I believe, primarily a pulp State. Can't the inventive minds of the country discover a more suitable paper base?

Another appalling enemy of the forests hereabouts, and, in fact, all forests, is fire. I have heard it stated that this season, owing to the dry weather, there have been something like 200 forest fires in the Maine woods—and within a month two forest fires have been witnessed right from the shores of Moosehead Lake. The fire-fighting service was promptly in action, but before the fire could be put out with the aid of nature (rain) a considerable area of valuable timber had been burned. Ask the fire wardens and lumbermen the cause of the fires and they invariably reply, carelessness with campfires or in smoking tobacco and cigarettes. The cigarette is generally credited with being the best starter of forest fires.

Still another recent enemy of timber has made its appearance in this region. A visitor notices whole mountainsides of dead spruce and upon inquiring the reason is told that the last few years "spruce worm" has settled down in certain sections of this country, eating up the leaves of the spruce and thereby ending the life of the trees. So in addition to man with his axe and torch our forests have to stand the various insect and fungus blights of nature, both domestic and imported, which have about exterminated the chestnut and are now threatening the spruce and pine. So while reforestation and replanting are essential and desirable, is it not also necessary to spend every effort to check the waste and destruction of timber which is going on all over the land, for what is taking place in the Maine woods is going on in other States in different ways? In the Catskill Mountains, State of New York, fine hardwood forests are being cut down to manufacture acid.

Therefore, as well as reforestation we need intelligent regulation and control of Nature's woods if we are not eventually to become the "barren sun-baken hills" of Persia mentioned in your editorial.

Kineo, Maine. PALMER H. LANGDON.

Photographing Sound Waves

To the Editor of the SCIENTIFIC AMERICAN:

There have been many newspaper and scientific articles published recently concerning the work of foreign inventors in the field of photographing sound waves which do not give proper credit to the several brilliant American inventors in this field, some of whom have recently made additional discoveries which promise much for a great improvement in the reproduction of sound waves recorded or stored on sensitive film by light rays on which the sound waves have been imposed.

The method of recording sound waves by photography has been well understood for many years.

Among the foremost workers in this field was Prof. C. E. Miller at the head of the Physics Department in the Case School of Applied Sciences in Cleveland. He first recorded sound waves by means of an open light focused on a sensitized photographic film in 1903, since which time he has made a careful study of the processes and has contributed a great deal to our knowledge of sound waves through the authorship of several standard works, among them "Sound Waves and Their Relation to Music."

Mr. H. L. Falk, then an unknown inventor in New Orleans, La., first recorded sound waves on sensitized glass plates in 1898, and has since and more recently perfected an apparatus for their reproduction.

Mr. Lewis A. Brinkman, then of the Chicago Scientific Institute, succeeded not only in photographing sound waves upon film but reproduced them by means of a selenium cell in 1915 or 1916.

Mr. N. Tenaka, formerly a citizen of the Flowery Kingdom, who for many years past has been a resident of Medford, Mass., has devoted much time to the solution of these problems and has designed a sensitive light cell which is said to be very satisfactory in its operation, although its composition has not been disclosed. He is endeavoring now to apply it to an improvement in phonographs, and those acquainted with his work seem to think that it will be successful.

The difficulty in the work has until recently been due to the slowness in action of the sensitive light cells produced to date. These were largely composed of selenium and their action or reaction to lights and shadows was not sufficiently fast to carry the rapid vibrations of most sound waves, which vary in the human voice from 1400 to 2900 vibrations per second.

Mr. Theodore W. Case of the Case Research Laboratories of Auburn, N. Y., about three years ago succeeded in making a sensitive light cell by the use of thalium, which has since become well known through its adoption by the U. S. Naval Department for signalling purposes. About thirty of the naval ships were equipped by Mr. Case with signalling devices which employed these cells, and the results of which in actual use have proved very satisfactory. He has more recently still further improved these cells by the use of barium instead of thalium, and is still engaged in experimenting along these lines. He has constructed several of these new cells for use in agricultural stations, experimental departments of scientific laboratories, and they are now employed in measuring daylight for lighting companies and other purposes.

A recent official bulletin just published by the University of Illinois announces the perfection of a new sensitive light cell, and says it seems possible that this discovery will make the movies of the future talk, so that there will no longer be the silent drama. The announcement continues: "The scientific discovery is that of an extremely sensitive and reliable photoelectric cell made in the physical laboratories of the University by Prof. Jakob Kunz. The photoelectric cell is a device for turning flashes of light into electric pulses, and is so sensitive that it reacts to light from stars which cannot be seen with the unaided eye."

More recently Mr. Falk of New Orleans, referred to above, and who has become well known through his invention of a liquid glass diaphragm used in reproducers on phonographs, has produced an extremely sensitive and inexpensive light cell by the use of barium. It has been found that these cells are impervious to atmospheric changes and apparently their life is permanent. Tests of these cells show that their response to the action of light is instantaneous. He is now engaged in the work of perfecting instruments and machines for utilizing them, both in phonographs and in moving pictures.

These inventions by Americans, which apparently antedate by several years the work of foreigners, whose work along these lines is just being announced, promise, when properly applied, to solve the problem of the speaking movies and greatly improve, if not entirely revolutionize the phonograph.

X. Y. Z.

Tractor Fuels

To the Editor of the SCIENTIFIC AMERICAN:

Our attention is called to a paragraph headed "Kerosene Not Always the Most Economical Fuel," which occurred on page 463 of your issue for June 11th, 1921. In this connection I should like to quote the results of our tractor tests for the summer of 1920. Under the rules of these tests, tractors are given credit only for the power delivered to the dynamometer, in brake-horsepower tests. The fuel economy of the 65 tractors tested, when loaded approximately to the rating given by the manufacturers, may be summarized as follows:

Of 53 kerosene tractors tested, the lowest showing in horsepower-hours per gallon was 4.85; the highest, 10.82; the average, 7.658. Of twelve gasoline machines, low, high and average figures were, respectively, 5.43, 8.52, and 6.976. Ten kerosene tractors had a better performance than the best record made by a gasoline tractor, and that their advantage was so pronounced that the average of the first thirty kerosene machines beat the best individual gasoline-tractor record. With our reports going out broadcast, it seems surprising that a contributor to the SCIENTIFIC AMERICAN should present results so widely variant. The figures given in your article approximate in some respects those of our draw-bar tests; but if this be the source of the error, draw-bar records have been compared directly with brake records. It seems incredible that a reliable contributor would make such a comparison.

It may be of interest to note that 1921 tests show four gasoline tractors better than 1920's best. The high figure is 9.81 horsepower-hours per gallon, no allowance being made for belt loss or for loss between engine and pulley.

E. E. BRACKETT.

University of Nebraska.

Loading Stations No Novelty in Illinois

To the Editor of the SCIENTIFIC AMERICAN:

I note in your November number an article on page 47 about "A Farmers' Loading Station." The description treats this as a new or unique establishment. Perhaps it is in California, but here in Illinois we would no more think of taking grain to market in sacks or bags than we would of cutting wheat with a cradle, and loading stations, or elevators, as we call them, are as common as stores; there are thousands of them in this state. Of course, they are of all sizes and kinds. Some of them are novel. For instance, at Sibley, Illinois, there is a corncrib, or rather corn warehouse and elevator, that has room for the storage of 130,000 bushels of ear corn. There may be other plants of this kind in the country, though I have never heard of any that were equipped in anything like the manner this one is. But loading stations are no novelty, and grain sacks are used only for clover and timothy seed or other grains sold in small quantities. L. S. ASHLEY.

Paxton, Ill.

The Psychology of Reading

To the Editor of the SCIENTIFIC AMERICAN:

A few months ago I read an interesting article concerning correct reading. The author pointed out the fact that most people limit their rapidity of reading by mentally repeating each word, instead of grasping the thought in each word structure at a glance. Is it not possible that a lack of standard printing practice has prevented most of us from developing the proper coordination of sight and mind necessary to make this kind of reading possible?

To illustrate, the text books supplied for our schools show a variety of type size, spacing, and column widths. It is not surprising that students who are taught from such literature seldom become really adept in the art of reading. Imagine trying to learn to operate a typewriter if one was forced to practice on several different keyboards. Our newspapers have developed a fairly uniform style of printing, and from my own observations, I believe that most people can read newspapers more rapidly than other literature.

Some one could certainly do the people a service by determining, through psychological research, the most advantageous kind of printing and then forcing publishers to accept it as a standard.

PAUL D. FLEHR.

Ironton, Ohio.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

SHEATHING FOR AIRPLANE PROPELLERS.—T. F. HAMILTON, Hamilton Aviation Field, Milwaukee, Wis. An object of the invention is to provide a construction in airplane propellers whereby the metal sheathing is prevented from buckling, due to the flexing of the propeller blade when driven at a high speed, and also whereby the accumulation of water, especially at the outer extremity of each blade tip, is prevented.

PLANE FOR AIRCRAFT.—J. F. BRICE, 60 Wall St., New York City, N. Y. The invention aims to provide improvements in aircraft, utilizing lifting surfaces commonly termed "aerofoils." An object is to provide a construction which will be capable of a far greater amount of speed with the same engine power without in the slightest effecting its lifting qualities. A further object is the construction of a device in which a given area will exert a far greater amount of "lift" than has hitherto been possible.

FLYING MACHINE.—F. G. HANEY, 915 W. 8th St., East Liverpool, Ohio. The primary object of this invention is to provide a flying machine which is capable of rising and descending in a vertical line. A further object is the construction of a machine which will incorporate certain mechanism permitting it to move at a tangent to both the horizontal and vertical, as well as the horizontal, and in which the course of the machine may be readily guided through the air.

FLYING MACHINE.—A. L. MARPLE, General Delivery, Narrows Park, Cumberland, Md. The invention is particularly designed as a land and air vehicle for carrying passengers through the streets of a city, or to distant points through the air. The construction is such as to permit of its being partially folded when in the streets or in storage, and when traversing the air is adapted to be extended to its full capacity so as to properly function as an airplane. It is constructed also for safe landing and departure from water, and permits of safe traveling through the water as a hydroplane.

Pertaining to Apparel

GARMENT SUPPORTER.—J. P. WILSON, 1125 Francisco Ave., Francisco Apt. No. 4, San Francisco, Calif. An object of this invention is to provide means whereby the tab carrying the button cooperating with the clasp will not become quickly worn or detached from the supporting means. The support includes a tape and clasp provided with a hinged tongue, said clasp presenting a plurality of openings, the tape being threaded through the openings and around the point of the hinged connection, and a button secured to the outer end of the tape adapted to cooperate with the tongue of the clasp.

BUCKLE.—A. J. WOOD, R. F. D. No. 3, Box 53, Birmingham, Mich. This invention relates to trouser supporting means, for engaging the top button-hole of the fly or front portion so as to prevent sagging of the trousers as well as the belt at this point. The buckle is provided with a hook or like device adapted to support the trousers, but will in no way interfere with the buttoning or unbuttoning of the trousers or usual working of the belt.

GARMENT.—B. LUSTGARTEN, 2233 80th Street, Brooklyn, N. Y. The invention relates to garments of a bifurcated type. One of the objects to provide a combination closure for the lower end of the leg members, by means of which the open end may be used in its full open position or may be drawn by means of a drawstring to provide a closure of the bloomer type.

GARMENT FASTENER.—A. ROCKE, 859 Beck Street, Bronx, N. Y. An object of this invention is to provide a garment fastener more especially designed for use on corsets and similar garments and arranged to permit the wearer to readily close or open the corset and without danger of the corset becoming accidentally open after it is closed. A further object is to permit of applying the fastener to various types of corsets without requiring essential changes in the construction thereof.

TIE HOLDER AND RETAINER.—M. W. REESE, 3216 Myrtle Ave., Omaha, Neb. The invention has particular reference to a necktie holder and retaining device for use in connection with soft collars. The principal object is to provide a tie former and holder which will closely stimulate a hand-tied tie, including means for fastening the same to the wings of the collar, which means may simulate any one of a number of fastening devices in general use.

Chemical Processes

PROCESS OF THE PRODUCTION OF AROMATIC ALDEHYDES AND THEIR SUBSTITUTION DERIVATIVES.—C. O. BENEDETTI and A. P. and W. VANSELOW, c/o Chocolate Products Co., Pratt and Concord Sts., Baltimore, Md. The invention relates to a process and apparatus for the production of aldehydes and their derivatives, and has reference more particularly to the monohalogen derivative of the corresponding aromatic hydrocarbon or its substitution derivative which is hydrolyzed by an aqueous-alkali solution to the corresponding primary alcohol, and this alcohol is then oxidized to the aldehyde by means of a hypochlorite solution.

PROCESS OF PRODUCING TITANIUM NITROGEN COMPOUNDS.—F. VON BICHOWSKY and J. HARTHAN, 1412 San Fernando Blvd., Glendale, Calif. The invention relates to a process of producing titanium nitrogen and the like compounds from such minerals as ilmenite, and one of the important features resides in the recovery or production of such compounds by heating ilmenite with an agent such as carbon and in the presence of an agent such as nitrogen, at a temperature of about 1100° C.

Electrical Devices

ELECTRICALLY-HEATED PRESSER-FOOT.—HETTIE E. RUDOLPH, Box 3484, Lowell, Ariz. The object of the invention is to provide on the presser-foot of a sewing machine an electric heating attachment so that the presser-foot serves, in addition to its ordinary function, the function of an iron to press seams, hems, pleats, tucks, etc., as they are being stitched on the machine. (See Fig. 1.)

SHAVING BRUSH.—J. C. PAGE, 1105 Mission St., San Francisco, Calif. Among the objects of the invention is to provide a self-feeding and electrically-heated shaving brush that is convenient to handle, ready for use almost instantaneously after turning on the heat, can be regulated as to the amount of soap to be fed into the brush, and can be conveniently carried along in a suitcase.

ELECTRIC FIXTURE FITTING AND METHOD OF MAKING SAME.—D. GOLDICH, c/o Arrow Tool Mfg. Co., Bridgeport, Conn. The invention has particular reference to a form of "hickey." An object is to provide means by which the fitting is simply and efficiently formed from a single piece of sheet metal, and which in its completed state presents a finished appearance, whereby smooth edges and surfaces are presented, so that the insulation is not worn out by contact with rough fittings.

LOCK.—D. HOFFMAN and F. EASTON, address D. H. F. Dubbon, 193 Third Ave., New York, N. Y. The aim of this invention is to provide a device more particularly adapted for use in connection with an electrical circuit of an automotive vehicle, but not necessarily limited to this adaptation, and by means of which it will not be necessary for an operator to utilize a key to complete closing and opening of the circuit. A further object is to construct a lock in which an alarm will be given upon an unauthorized person endeavoring to manipulate the same.

Of General Interest

WASTE FUEL OIL SALVAGING BARGE.—H. M. FACKERT, 400 W. 23rd St., New York, N. Y. An object of this invention is to provide a means for expeditiously separating fuel oil from water as the same is discharged from the tanks of oil-burning vessels. A further object is to provide an apparatus which automatically operates to receive the mixed oil and water, separate the same, discharge the water and retain the oil. The apparatus is inexpensive to operate, and highly efficient in its purpose. (See Fig. 2.)

KITCHEN CABINET.—W. M. GALLAGHER, 215 State St., Litchfield, Ill. The invention has for its object to provide a device which has a relatively great capacity, being adapted to hold a large number of utensils, which permits of access to any particular article without the necessity of removing or displacing any of the other articles contained in the cabinet, which is convenient, simple and durable, attractive in appearance, sanitary in use, and inexpensive to manufacture.

ATTACHMENT FOR COLLAPSIBLE TUBES.—J. S. TURNER, address Turner White Metal Co., 218 Raritan Ave., New Brunswick, N. J. This device is designed to produce a closure and spreader for use with collapsible tubes, more especially those containing glue. The glue of collapsible tubes tends to harden at the neck, making an irregular seat for the closure, whereby leakage is liable to result as well as hardening of the tube contents. The device includes a threaded zone on the shank of the spreader, the arrangement being such that a tight closure is effected and no mutilation of the threads in the neck or disruption resulting from the repeated insertion and removal of the spreader. (See Fig. 3.)

HAND BAG.—A. KULICK, c/o Elk Leather Goods Co., 130 W. 29th St., New York City, N. Y. This invention relates to hand bags having an interior main pocket and interior side pockets on opposite sides of the main pocket. The object is to provide a hand bag which is exceedingly simple to manufacture, and without seams in the body, and to render the bag very durable and neat in appearance.

RAT TRAP.—J. F. KELLER, Box 233, Ottoville, Ohio. An object of the invention is to provide a trap in which the bait is positioned upon a hinged platform equipped with a novel form of trigger mechanism which will quickly operate the trap door after the rat has entered. A further object is to provide a trap which may be easily kept clean, which is strong, simple, and efficient in use, and which will be comparatively inexpensive to manufacture. (See Fig. 4.)

FINDER.—F. A. WENMAN, 348 1st St. Brooklyn, N. Y. This invention has reference to such finders as are used in connection with photographic instruments. The primary object of the invention is to provide a finder which may be accurately adjusted for both horizontal and vertical planes, and which is so arranged that camera lens may be moved to register into a position which will permit of a reproduction of an image within the camera corresponding to the area included within the field of the finder.

METHOD FOR PRODUCING WOOD FLOUR.—J. J. CUNNINGHAM, 5 Horicon Ave., Glens Falls, N. Y. The invention relates to a wood flour such as is used in the manufacture of phonograph records and other articles. The object is to provide a method for producing wood flour from raw sawdust, the method consisting essentially of screening the sawdust, grinding the screened sawdust under development of heat to vapor-

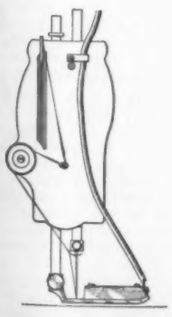


Fig. 1. H. E. Rudolph's electrically heated presser foot for sewing machines

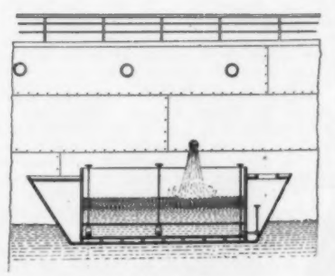


Fig. 2. Barge for salvaging waste fuel oil, patented by H. M. Fackert

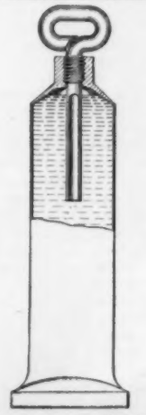


Fig. 3. Attachment for collapsing tubes, developed by J. S. Turner

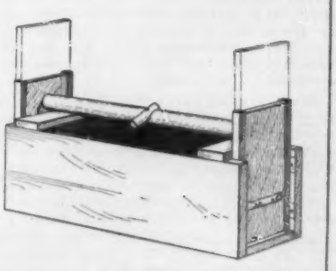


Fig. 4. J. F. Keller's rat trap with novel means of springing the trigger

ize the moisture, and bolting the sawdust to separate the coarse from the wood flour.

SWING.—W. E. BRAYMER, Box 444, Kiefer, Okla. The object is to provide a foot rest for so-called "porch" swings, the rest being so constructed that it may be readily attached to a standard type of swing. A further object is to provide spring means in connection with the rest which will permit the same to lower when the user places his feet thereon preparatory to entering the swing.

DISPLAY CARD.—J. DOMBER, 93 Franklin St., New York, N. Y. This invention has for its object to provide a display card which may be utilized by dealers or in window display, and by means of which a piece of cloth may be presented in such manner as to more nearly conform to the appearance of a completed garment, although the card may readily be utilized as a cover plate for the folder receiving a number of pieces of cloth, one of the pieces being shown in the manner described.

DISPENSING DEVICE.—L. W. TIFFANY, Winsted, Conn. The invention aims to provide a device of this character, more particularly adapted for use in connection with pins, paper clips, etc. A further object is the construction of a device by means of which the pins or clips may be readily withdrawn and which shall also present an extremely neat appearance.

EGG BEATER.—U. G. TEETSELL, 45 John St., Tarrytown, N. Y. The primary object of the invention is to provide a form of handle for egg beaters which is offset and will thus do away with the disadvantages commonly found in devices of this nature, among them the scratching of the operator's knuckles on the gear wheel and the inability to see just when the material has been stirred in cases where small quantities of material are used.

REPOURING ATTACHMENT.—J. P. QUINN, 157 St. Ann's Ave., New York, N. Y. The invention aims to provide an attachment for use in connection with percolators which are utilized for the percolating and dispensing of beverages in restaurants and like places. The object is to provide an attachment by means of which the operator may readily effect a withdrawal of fluid from the base of the receptacle, and a reintroduction of the same at the upper end of the receptacle, without splashing or injury to himself.

FLEXIBLE BRACELET.—W. MAGUIRE, and A. BAUSCH; address A. Bausch, 822 Flatbush Ave., Brooklyn, N. Y. The invention has for an object to provide a bracelet box and connecting means wherein the various boxes or parts of the bracelet are articulated slightly in a simple and effective manner, and in which upstanding, bendable lugs are presented for receiving coupling rings so that when encircling two lugs a pivotal hinge connection will be provided.

ADVERTISING DEVICE.—H. K. MACDOUGALL, c/o Y. M. C. A., Tientsin, China. The general object of the invention is to provide a mount for the advertisements disposed longitudinally of a car beneath the roof in the customary position of such advertisements and having means to intermittently turn the advertising mount about its own axis through the medium of a fan adapted to be turned by wind pressure due to the motion of the car.

REFRIGERATOR.—W. L. HUMMEL, 2911 N. Richmond St., Chicago, Ill. An object of this invention is to provide a refrigerator having a plurality of compartments and provided with means operable to permit air to circulate freely from one compartment to another when the compartments are closed and to prevent the passage of air from any compartment to the adjacent compartment when the door of that particular compartment is opened.

COMPENSATING DEVICE.—G. O. GRAY, Box 234, Butte, Mont. The invention has for its object to provide a device of the character specified especially adapted for use with chart display apparatus, for compensating for difference in speed due to the unequal size of the rollers while the chart is winding from one, and winding on to the other.

PAVING BLOCK AND PROCESS OF MAKING THE SAME.—J. S. DOWNARD, 1615 American Exchange Bank Bldg., Dallas, Texas. The invention relates to paving blocks used as a wearing surface upon a suitable base or as a pavement without a base other than the block itself. The process consists of mixing particles of natural asphalt rock with a mastic consisting of rock asphalt powder, pure asphalt, and a substance having a high melting point, introducing the mixture into a mold to form blocks, and subsequently cooled with water.

CATAPULT AND PROJECTILE THEREFOR.—C. E. TIEDEMAN, 25 W. Fulton St., Gloversville, N. Y. The purpose of this invention is to provide a catapult of extremely simple construction, which is manually operable to impel a ring-like projectile in different velocities and in such manner as to maintain the projectile in upright position during flight. A further purpose is to provide a projectile constructed to permit of its looping a target and causing its adherence thereto so that the accuracy of the shot may be determined.

BEDSTEAD AND OTHER FURNITURE.—S. B. GAMBLE, West Perth, West Australia, Australia. The invention relates to a dovetail fitting formed of sheet metal, which may be used in the joints of bedsteads and other articles of furniture, an object is to provide a fitting of this kind particularly applicable for connecting the frame of a spring mattress with the usual wooden bedposts.

SOUNDING DEVICE.—V. H. CONLEY, 3615 Bernard St., Chicago, Ill. The object of this invention is to provide a sounding device to take the place of what is commonly known as a lead line, such device being adjustable to the work to which it is to be subjected. The device includes a blade, pins secured to and extending outwardly from the blade and being adapted to lie at an angle to the direction of travel. By this device it is not necessary to slow the speed of the vessel.

METHOD OF FIXING COLOR MARKINGS ON THERMOMETER STEMS.—H. T. KRIGEL, c/o Verstendig, 766 Grote St., Bronx, N. Y. The invention relates to the manufacture of high-class clinical thermometers and includes means for fixing the markings on the stem by firing, the marking being first applied through the medium of a vitrifiable color which will fuse when subjected to the heat of the firing kiln. Means are provided for keeping the mercury bulb sufficiently cool to prevent such expansion as will cause fracture of the instrument.

AUTOMATIC FIRE ALARM.—C. A. ANDERSON, 803 Coalmont St., North Braddock, Pa. The object is to provide a device adapted to be moved around from place to place at various locations within a residence, factory, or mercantile establishment wherever there seems to be a special source of danger. The initiating cause of the alarm is a form of thermostat, and consists of metal plates adapted to be warped from a normal arrangement by a rise in temperature.

MONOLITHIC WALL.—M. J. GRAHAM, 1927 Calder Ave., Beaumont, Texas. Among the objects of this invention is to provide a monolithic wall of simple inexpensive construction in connection with which both the inside and outside surfaces may be similarly formed and ornamented as desired, as well as one which will be strong and durable and is capable of easy and quick formation.

HAME AND TRACE CONNECTER.—F. H. HAPGOOD, Box 156, Stevenson, Wash. The purpose of this invention is the provision of a device for connecting a hame and trace formed of rope, which eliminates the necessity of splicing the trace, and permits of the longitudinal adjustment of the trace while at the same time securely maintaining it in adjusted position without subjecting it to any appreciable degree of wear.

PRINTER'S SLUG AND RULE.—W. E. TAYLOR, 202 W. 20th St., New York, N. Y. The invention relates to slugs and rules and molds therefor to produce slugs and rules in strip form. The slug as invented by this patent includes a solid body portion having a plurality of parallel openings extending from one end to the other, and the material between said openings forming a longitudinally extending strengthening web.

ROAD CONSTRUCTION.—G. H. PADGETT, 716 N. A St., Edwards, N. Y. The primary object of this invention is to provide a track or wearing rail in roadways on which vehicles may be driven, and to so construct the track that it may serve as a means for draining the road, thus helping to maintain the road in good repair.

COMPUTING DEVICE.—G. D. JOHNSON, address Mrs. G. D. Johnson, Administratrix, 3709 3d Ave., Bronx, N. Y. The invention relates to a device for computing weight per square foot of leather belting. An object is to provide a mechanical device comprising parts bearing scales having certain relations so that by setting certain parts at certain relative positions the weight in decimal ounces, the total weight of the roll being known, is indicated upon the device without the necessity of the use of additional calculating instruments.

SPRING PAD.—S. S. MARCUS and S. KRAKAUER, 1780 Morrison St., Bronx, N. Y. This invention has for its object to provide a spring or cushion pad which is simple in construction, cheap to manufacture, and arranged for convenient insertion in a casing in any desired number of units. Another object is to permit of conveniently forming the pockets in pairs for corresponding pairs of springs.

WALL CONSTRUCTION.—D. J. FLYNN, 222 Elm Court, Elizabeth, N. J. The object of the invention is to provide a wall construction formed of hollow building blocks arranged to compensate for any irregularities in the blocks when building the inner and outer wall sections and tying the same together. Another object is to provide a block capable of use as a whole, or to be split by the mason as desired.

METHOD AND MEANS FOR PRINTING.—L. E. WOODWARD, 6300 Montgomery Road, Cincinnati, Ohio. This invention is particularly intended for the printing of theater tickets, by means of a cylindrical printing plate composed of half sections produced by setting up the type in separate chases with parallel lines, the matter in the lines of one chase running continuously with the corresponding lines in the other chase, and forming semi-circular matrices, the plate formed from which will present the printing elements in a continuous spiral.

TRAP.—T. R. SCHUIRMANN, The Rexall Store, 209 Green St., Chenoa, Ill. The invention relates to traps for catching rats, mice and other rodents. An object is to provide a sheet-metal trap construction, including two compartments for retaining the rodents, until it is desired to empty the trap or immerse the same, the trap being provided with a removable bait-holding device which will attract the rodents, but will prevent their access thereto for eating the same.

LEG BLOCK.—S. BATTAGLIA, 52 Beaver St., Brooklyn, N. Y. The primary object of the invention is to provide a leg block for use in connection with furniture construction, which will serve to firmly retain the leg in its proper position. A further object is to provide a leg block which may be applied in a minimum of time, and in which any play which may come into being may be readily compensated for so as to again firmly affix the leg.

HOLDER FOR GROWING PLANTS.—E. KUEBLER and O. NIEDERBERGER, 1024 Bryant Ave., New York, N. Y. The invention relates to plant holders and more particularly to a receptacle for growing plants, which is especially designed for indoor use. The device is so constructed that air is permitted to enter the soil contained in the receptacle, which is formed with slats, which at the lower portion form drainage space when the plant is watered, the unabsorbed water being caught by a drain pan.

WRISTLET.—J. P. KELLY, 207 Eighth Ave., New York, N. Y. The primary object of the invention is to provide means adapted to be worn upon the arm of the operator to catch the drip from a sponge, cloth or other washing implement, in washing painted surfaces, windows and the like. The device is so formed that it may be readily attached to or detached from the operator's arm.

TRIPOD FOR MACHINE GUNS.—J. F. O'MALLEY, Box 323, Mount Vernon, N. Y. This invention has for its object to provide a tripod for machine guns arranged to enable the gunner to sight the gun quickly and accurately and to hold the same securely in adjusted position during the firing. Another object is to permit of firmly setting up the tripod on soft or rocky ground.

ARTIFICIAL HAND.—R. F. ARMSTRONG, La Cygne, Kansas. The object of the invention is to provide an artificial hand which is capable of readily and easily performing all of the important functions of the human hand, and which is of extremely simple and durable construction, reliable in operation and easy and inexpensive to manufacture.

TICKET CARRIER.—H. RUSCHER and O. S. PAYZANT, c/o O. S. Payzant, 70 East 45th St., New York, N. Y. The invention has for an object to provide a carrier wherein the tickets are not only held at a proper angle for dispensing, but are prevented any appreciable reverse movement when pressure is brought to bear thereon preparatory to their removal. A removable spring is arranged at the discharge end to resiliently resist removal of the tickets.

DEVICE FOR HOLDING MATRICES IN STEREOPLATE CASTING BOXES.—C. WINKLER, Berne, Switzerland. The purpose of this invention is a device for holding matrices which is opened, for the purpose of putting in the matrix, and then closed, for holding the matrix by means of a worm gear, the device holding the matrix will remain in position when opened, thus enabling both hands to be used for manipulating the matrix.

COIN STACKER.—P. F. FRIESEN, First National Bank, Hillsboro, Kans. An object of the invention is to provide an inexpensive device into which coins can be readily placed and which will by gravity stack the coins and indicate the number or value of the stack. A further object is to provide a stacker which may be used for stacking coins of different sizes by substituting different inner tubes.

REPRODUCER.—V. C. HOLLAND, address W. H. Watson, Keene, N. H. An object of this invention is to provide a reproducer having a diaphragm of cotton fiber suitably treated with chemicals and vulcanized to give it the necessary reproducing qualities, and which will enable a larger diaphragm to be employed than with materials commonly used, and will operate not only to more perfectly reproduce sound, but dispense with the defects in the sound due to engagement of the needle or stylus with the record.

SHOE.—L. C. KENTON, 622 Market St., Chattanooga, Tenn. This invention relates more particularly to the making of shoes of the blucher type, for children's use, having a double tip and vamp portion to provide a smooth interior surface such as to obviate the necessity of a lining for the shoe at the forward part, so that the lining may only be disposed in the top part of the shoe and thus have the appearance of a drill-lined shoe.

STRIPPING COMB.—M. J. COLLINS, 1125 Park Ave., New York, N. Y. The object of the invention is to provide a stripping comb, such as is used in the grooming of rough-coated terriers, in preparing the dogs for exhibition, by means of which an operator will at all times have an instrument available which will be in perfect condition for use, in that the cutting edge may be readily sharpened, and the comb readily and quickly cleansed.

SCALE.—J. E. BURTON, 149-A Hamilton St., Cambridge, Mass. An object of the invention is to provide a scale which may be installed in the ice-box of a refrigerator, and which will occupy a comparatively small space. A further object is to provide a scale which will automatically register the amount of ice deposited, and enable a housewife to see just how much ice there is in the box at any time.

DECORATED ARTICLE.—A. N. EPSTEIN, 23 Judge St., Brooklyn, N. Y. This invention relates to articles of wood, metal, vitric, ceramic, fibrous or textile fabrics, and its object is to provide an article having a highly ornamental and effective glass bead or crystal decoration. Another object is to permit of producing a surface ornamentation which is not effected by changes in temperature or by moisture, and is not liable to peel off, crack or become injured.

DETERGENT.—O. M. WEIGLE, 609 Jefferson St., Fulton, Mo. Among the objects of the invention is to provide a detergent for cleaning the hands or body which will have a high efficiency, will be cheap to manufacture, and will leave the skin soft and in good condition; it is especially useful as a cleansing agent for the hands when they become very dirty. The composition consists of: cornmeal, 85 per cent; powdered soap, 14 per cent, and boracic acid, 1 per cent.

PENCIL CLIP.—J. R. FITTON, c/o C. E. MORSE, 511 West 60th Street, Chicago, Ill. Among the objects is to provide a simple clip that is adapted to be applied to a pencil or pen casing and which has means for engaging with the fabric of a garment, whereby the pencil is effectively held against movement relative to the garment. A further object is to provide a pencil clip that is practical commercially and inexpensive to manufacture.

HATPIN.—A. C. CLAUS, c/o Edgar Freed, Mohawk Bldg., Portland, Ore. The purpose of this invention is to provide a hatpin, for ladies' hats, which is extremely simple and of inexpensive construction, which can be readily applied to the hair and hat for securely retaining the hat to the hair, and at

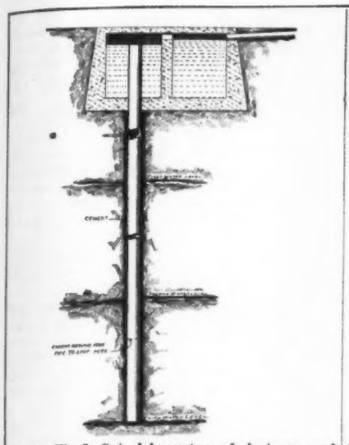


Fig. 5. W. J. Snively's system of drainage and disposal of offensive wastes

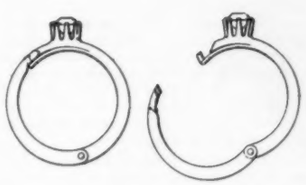


Fig. 6. Finger ring that does not have to go past the knuckle, invented by D. P. Fontana

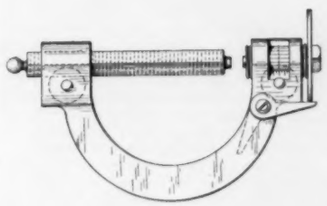


Fig. 7. Micrometer calipers that takes the place of several tools, patented by G. Cousins

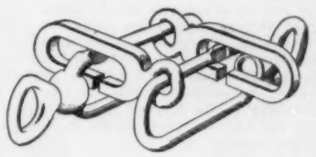


Fig. 8. Quick-operating cable coupling put out by J. W. H. Blee and A. P. Powell

the same time permitting the ready withdrawal thereof when removing the hat.

DRAINAGE SYSTEM.—W. J. SNIVELY, address W. J. Hunter, Main St., Greensburg, Pa. The invention particularly relates to a drainage system whereby sulphur water and all objectionable waters that flow from coal mines into creeks and streams, can be gotten rid of, the same system may also be applied to dry up swamps and marshes. The object is to drain the water to a sedimentation chamber, and from there carry it by pipe drilled into the ground to a depth of the third water level, thus preventing the pollution of the upper water stratas. (See Fig. 5.)

FINGER RING.—D. P. FONTANA, 314 W. 19th Street, New York, N. Y. Among the objects of this invention is to provide a finger ring construction in which the ring body is formed of hingedly connected sections which permit of the opening of the ring during its application or removal. By this method it is not necessary, as in a solid construction, to make the internal diameter of sufficient size to readily slip over the knuckle, which so often results in a loose fit. (See Fig. 6.)

Hardware and Tools

MICROMETER CALIPERS.—G. COUSINS, c/o C. W. Dings, 173 W. 1st St., Oswego, N. Y. The chief object of this invention is to provide a readily adjustable and easy reading device, which will obviate the necessity of possessing 2-inch, 3-inch, 4-inch, etc., of the ordinary forms of micrometer calipers; the length of the regularly serrated bar limiting the extent of its application. Its simple construction for rapid adjustment, and absence of delicate parts, render the caliper a most desirable addition to unskilled, or expert machinists' kits. (See Fig. 7.)

VISE.—J. R. MARTIN, 132 W. 16th St., New York, N. Y. The invention relates to work-holders used on planers, shapers, milling machines and other metal-working tools. The object is to provide a vise or work-holder arranged to accurately seat the work on the base of the vise without requiring hammering the work down by the operator. Another object is to permit of applying the device to vises as now generally construed.

CABLE COUPLING.—J. W. H. BLEE and A. P. POWELL, Box 426, Harrison, Idaho. The purpose of the invention is to provide means by which a rapid coupling and uncoupling of two lengths of cable can be effected without the possibility of the coupling being accidentally uncoupled. The device comprises companion coupling members, each comprising a connecting link and a coupling link permanently and slidably connected, each of the coupling links being detachably associated with the connecting link of the other coupling member. (See Fig. 8.)

SELF-ALIGNED INSERT.—W. W. WHITE, 93 Halsey St., Brooklyn, N. Y. The invention has particular reference to metallic or other inserts used in connection with concrete or cementitious body portions. An object is to provide a simple, economically manufactured, compact insert which when placed within a mold to be embedded in a concrete body portion aligns itself properly and maintains its alignment thereafter.

VISE.—L. POSCH, 201 Odgen St., Jersey City, N. J. The object which this invention has in view is to provide a gripping structure for vises and other mechanism which will grip articles of different sizes and shapes and will at the same time accommodate itself to the particular shape of the article to be gripped. Another object is to provide a gripping jaw formed with a number of nested parts which will automatically assume a straight line or an irregular line as pressure is brought to bear thereon.

HACK SAW.—J. SIDDON, 110 Melchon Place, Joliet, Ill. An object of the invention is to provide a hack saw in which the use of adjusting screws to hold the saw blades is obviated. A further object is to provide a device that has means for holding a saw blade in either vertical or horizontal position, and to provide means for holding saw blades of various sizes.

GUIDE OR GAGE FOR RECIPROCATING HAND TOOLS.—H. BRIGGS, Hasbrouck Heights, N. J. Among the objects is to provide means whereby the operation of the tool is rendered more positive, to provide means whereby the handle may be locked to the tool to prevent its accidental disconnection, and to provide a handle which may be adjusted to the plane of the tool forming a convenient hand-hold at the forward end of the tool and assisting in its manipulation.

DRAWING INSTRUMENT.—S. HOFFMAN, J. SCHWARTZ and I. HOLDEN, address M. Lavitt, 256 Broadway, New York, N. Y. This invention relates to what is known as an ellipsograph, and has for an object to provide a construction wherein by a quick adjustment different forms of ellipses may be drawn. A more specific object is the provision of an ellipsograph formed on the general principles of a compass with an adjustable guide arranged to guide the scribing member for producing ellipses of different sizes and shapes.

VISE.—T. SZYLDEROWICZ, 832 E. Rau St., Shamokin, Pa. An object of this invention is to provide a vise, and to provide the jaws of the vise with conical extensions, said extensions curved in cross-section and tapering to their outer ends so that wire or other device can be conveniently bent around either or both of the extensions and the bend be given the desired arc, coil or curvature by reason of its location between the extensions.

WRENCH.—B. G. PATTERSON, 403 Tradesmen's Bank Bldg., Oklahoma City, Okla. The invention has for its object to provide a wrench which may be quickly and easily adjusted to operate upon various objects, which is automatically locked in adjusted position, which may be readily released, and which is of simple and durable construction, reliable in operation and easy and inexpensive to manufacture.

COMBINATION LOCK.—R. ELCOCK, Victoria Mansions, Eloff St., Johannesburg, Transvaal, South Africa. The invention relates to locks in which movement of the bolt is dependent upon a prescribed positioning of rotatable letter rings or movable numbers. An object is to ensure that no opening movement of the bolt can occur until all the gates of all the movements are alined, thus preventing the position of the gates being felt individually.

SUPPORTING HOOK.—T. H. RYAN, 116 Peshine Ave., Newark, N. J. The invention aims to provide a device commonly known as a "pot hook." The primary object is to provide a supporting hook adapted for use by painters or other mechanics, and by means of which the bail may be readily attached and detached therefrom, and the device readily attached to the supporting member, such as a ladder, from which it is to be suspended, yet when attached will reduce the liability of its accidentally becoming detached.

SURVEYOR'S INSTRUMENT AND RANGE FINDER.—J. CASERANI, 2200 Leatherwood St., Butte, Mont. An object of the invention is to provide an apparatus which is extremely simple in construction, and easy to operate without the employment of complex mathematical rules. A further object is to provide a plum level attachment which serves to determine easily and accurately the amount of elevation or depression from the horizontal of any stated point.

TWIST DRILL.—F. A. JOSEPH, Princes Bldg., Hong Kong, China. The invention has reference more particularly to twist drills whose cutting edges are irregular in scribed outline so that the cutting edge of one flute of the drill leaves zones of metal in the hole which are cut by the cutting edges of the other flutes of the drill. An object is to provide a drill from which the swarf or chips will be easily cleared.

POCKETKNIFE.—P. W. HALLVARSON, Black Diamond, Alberta, Canada. The main object of the invention is to reduce the cost of producing a knife of this character by constructing the handle from a single sheet of material which is stamped to provide the blade-receiving compartment, which will be extremely rugged, whereby the same will withstand hard usage.

COMBINATION TOOL.—M. R. KRONERT, 443 W. Chicago Ave., Chicago, Ill. The invention relates to a combination square, level, and device for indicating the position of a piece of work having a circular wall relative to a milling cutter or the like in order to properly mill a key-seat or the like in the work, and to insure the proper engagement of the cutting tool with the work to mill a slot or the like of a given size.

WRENCH.—J. J. THOMAS, Box 153, Balfour, N. D. An object of this invention is to provide a wrench with means operable to releasably and firmly maintain the gripping parts in adjusted position, and means for gripping non-circular articles, and also objects circular in section when the handle is swung in one direction, and to release the object when swung in the opposite direction.

CHAIN TONGS.—C. ASHMUSEN, 3 Fulton Street, Albany, N. Y. The object of the invention is to provide pipe tongs having gripping means which conform to the shape of the pipe pivoted to the lever arm and supplying in conjunction with the gripping means, means for connecting the free end of the gripping means to the lever arm and for locking the connecting means in engagement with the lever arm.

HINGE ANCHOR FOR TOILET SEATS.—G. C. DOBSON, 4547 Park Ave., New York, N. Y. The object of the invention is to provide a hinge anchor for toilet seats arranged to securely and firmly connect the seat with the hinge to allow proper up and down swinging of the seat without danger of injuring the seat or the hinge post. The hinge is simple, durable, and not liable to get easily out of order.

LOCK.—B. GREENISON, 171 W. 71st Street, New York, N. Y. The invention relates to a lock construction which will serve to reduce the risk of an unauthorized person opening the closure, to a minimum. An object is to provide a lock, the appearance of which is no different from that of a conventional lock, which an unauthorized person would be led to believe that a skeleton or master key would open, but which cannot be opened without a special form of key.

WRENCH.—J. C. MAHAN, 2304 Washington St., Lincoln, Neb. This invention has for its object to provide a wrench especially adapted for twisting together wire cables in woven wire fences, and drawn cables around the end and corner posts. The head consists of sections detachably connected and adapted to embrace the wires, together with pivotally connected members having jaws for rotatably engaging the head, said head and jaws having interengaging means for constraining the head to turn in one direction when the jaws are vibrated.

SAW RELIEVING DEVICE.—M. H. MCCORMICK, Benford, Texas. The invention relates to a device by means of which the corners of the gullet between the teeth of a saw are operated on. The device may be conveniently associated with a sharpening machine. A further object is the construction of a device which shall operate upon each side of the saw upon the corners of the gullets, as the saw is moved through the device.

COMBINATION CURTAIN AND SHADE HOLDER.—J. W. MOTT, 800 N. 11th Street, Springfield, Ill. An object of the invention is to provide a light metal combination curtain and shade holder for windows, having adjustable shade brackets adapted for operative engagement with window shades of various lengths, said holder being quickly and easily adjusted to accommodate shades of various sizes and curtains of various widths.

Heating and Lighting

FIREPLACE.—J. E. LANGFORD, Kin Kin, Cooran, Queensland, Australia. The invention relates to a form of fireplace devised for the purpose of heating two rooms with one fire, and has for its object the attainment of economy in fuel, economy in construction, economy in labor of attendance, safety in use, and also the convenience of permitting the fire to be left burning when it is so desired.

BURNER.—E. E. CORNWELL and J. H. MCCREADY, 622 E. 6th St., Okmulgee, Okla. The inventors have been granted two patents on gas burners of a similar nature. The inventions relate more particularly to gas burners adapted for return tubular boilers and stills. The object is to provide a burner which is of simple and durable construction, reliable in operation and inexpensive to manufacture and apply, and which provides for a thorough uniform mixture whereby the fuel is completely consumed and a maximum amount of heat evolved.

WATER HEATING ATTACHMENT.—M. STARR, 516 West Third St., Plainfield, N. J. This invention is especially designed as a water heating attachment for coal ranges provided with water backs arranged in the fire box. One of the objects is to

provide a simple and inexpensive attachment which may be positioned in the fire box adjacent the water back to serve as a medium for heating when the coal range is not in use, the device may also be used for cooking purposes by shifting its position directly beneath the lids of the stove.

RADIATOR.—A. V. KNOLL, 1525 College Ave., Davenport, Iowa. Among the objects is to provide a radiator having tubes which are of varying thicknesses along the width of the tube, the cross section of the tube presenting a fluted or corrugated contour, whereby the expansion of the tube can occur as when the water freezes in the tube, without injury to the latter. A further object is to provide lock seam joints, thereby preventing leaking.

GAS REGULATING VALVE.—L. E. TROSCLAIR, 5924 Magazine Street, New Orleans, La. The invention relates generally to valves which are automatically operable by the pressure of one fluid to control the flow of another fluid, and more particularly to a valve which is operable by the pressure of steam within a boiler to control and regulate the supply of gas to burners used in heating the boiler.

HEATER.—W. R. JONES, Summitville, Ind. The object of the invention is to provide a heater which will efficiently radiate the heat generated by the combustion of solid, liquid or gaseous fuel, which is easily controlled, and which is of simple and durable construction, reliable in operation, and easy and inexpensive to manufacture. Features of the device are the air-feeding and heat-distributing means arranged between the firebox and the casing.

LIQUID FUEL FURNACE.—I. PRIBBLE, 700 Topeka Ave., Topeka, Kan. The invention relates more particularly to coal oil burners of the type wherein air and steam vapor is mixed with the oil vapor, a purpose being to provide a burner which insures the proper and uniform mixing of the fluids to prevent the formation of carbon. A further object is to provide a simple means for controlling the supply of the fluid to the burners.

Machines and Mechanical Devices

ATTACHMENT FOR PIPE MACHINES.—L. P. HUFSTEDLER, General Delivery, Tulsa, Okla. The invention has for its object to provide an attachment adapted to be arranged between the dies and the chuck of a pipe machine, for cutting the pipe at such point, wherein a ring is provided for attachment to the die frame, said ring having means for carrying a cutter, and having means for adjusting the cutter toward and from the axis of the pipe.

PICKER STICK.—W. F. DAVITT, c/o Messrs. Laggart, Tuttle, Wyman & Starr, Merchants Bank Bldg., Manchester, N. H. The invention relates to a picker stick mechanism or motion for looms, its object is to provide a device which eliminates all straps except the lug strap, which operates in such a manner as to throw the shuttle straight across the loom and on the race board, which precludes all possibility of the picker stick jumping out of its holder with resulting damage to the cloth or shuttle or both, and which is simple and durable.

TEARING MACHINE.—C. H. CLIFT, 54 Brookside Ave., Nyack, N. Y. This invention refers to a machine for mechanically tearing material fed therethrough, and aims to provide means for stretching the material transversely to smooth it of wrinkles whereby it will accurately register with the tearing machine, the device being adjustable to effect a tearing of the material into strips of various widths and lengths.

WASHING MACHINE.—J. C. AKER and M. C. WILLIAMS, 531 East 3rd St., Duluth, Minn. An object of the invention is to provide a manually operable device in which a pair of dashers are simultaneously reciprocated in opposite directions. A further object is to provide a machine which will be simple, durable, efficient in use, and comparatively inexpensive to manufacture.

FILM-DRYING NOZZLE.—R. C. HUBBARD, 203 West 146th St., New York, N. Y. This invention relates to the drying of motion-picture films, and has for its general object to provide nozzles adapted to deliver jets of air against the film with equal pressure at opposite sides, to dislodge water therefrom, by blowing the water from the film immediately before entering the dryer to complete the drying operation.

SAFETY DEVICE FOR MOTION-PICTURE MACHINE.—J. E. WOODLAND, 4842 Ashland Ave., Richmond Hill, L. I., N. Y. The object of the invention is to provide a simple and compact apparatus which can be applied to any type of moving-picture machine, and which operates a shield to cut off the light from the celluloid film whenever the film breaks or becomes disarranged, independent of the speed of the power mechanism operating the film. The device can be readily reset upon the repair of the film.

SPINNING ROLL FOR SPINNING MILLS.—E. H. WILSON and W. C. EHRENFELD, c/o Dural Rubber Co., Flemington, N. J. An object of the invention is the provision of means whereby rollers in spinning mills, especially those used for drawing the thread, can be very simply and easily repaired and replaced in the mill without requiring that they be sent back to the manufacturer. The device comprises a removable sleeve which can be placed on and removed from the roll by any workman of average skill.

STOP MOTION.—H. BERLIN, 57 W. Houston Street, New York, N. Y. The invention relates more particularly to knitting machines. The primary object is to provide a mechanism in which if one of the threads of the machine breaks, the machine will automatically stop in order that the article made by the machine will be free of imperfections owing to a continuation of the knitting operation when one of the threads has been broken.

SELF-PROPELLING TRAVELING CRANE.—G. BRUN, No. 1 Rue Jules Lefebvre, Paris, France. The invention has for its object to provide a crane capable of assuming all the positions that are required for the handling of loads, with a motor mounted on the platform of the crane and serving for lifting the load, also to drive the wheels of the platform and to turn the crane around its vertical axis, and the arrangement of the mechanism is such that the crane is capable of simultaneously lifting, swinging, and transporting the load.

SWELL CHECK FOR LOOMS.—E. LAVALLEE, address A. M. Surprenant, 200 Oak Hill Bldg., Pawtucket, R. I. Among the objects of the invention is to provide a device for permitting the comparatively easy entrance of the shuttle into the shuttle box, but for preventing rebound and to lock the shuttle in the box until the next stroke of the picker, wherein the pressure of the check is yieldable, and wherein the extent of the breaking action may be varied.

WELL MEASURING DEVICE.—R. C. MASON, 1419 Quaker Street, Tulsa, Okla. An important object of this invention is to provide a measuring device which may be conveniently mounted on the upper end of the well casing and engaged with the cable of the drill or the sand line for indicating to the attendant distance which the cable extends into the well.

OIL CUP.—L. C. DUTRO, 1235 Elm Ave., Long Beach, Calif. The inventor has been granted two patents of a similar nature relating to oil cups having an automatic feed of oil controlled by the temperature of the bearing. An object is to provide a device which will feed oil to cool the bearing as the bearing increases in temperature and which will automatically cease feeding as the temperature of the bearing falls. The cup being airtight the flow of oil will cease under normal conditions.

MACHINE FOR CUTTING BEVEL GEAR WHEELS WITH HELICAL OR STRAIGHT TEETH.—V. G. DARTOIS, 4 Boulevard Malesherbes, Paris, France. The machine invented by this patentee is capable of use for cutting either bevel gear wheels with helical teeth or bevel gear wheels with straight teeth, and is distinguished by a novel means for regulating and producing with precision the different motions of the cutting tool and overcomes defects in the operation of cutting the teeth of bevel gears by the usual methods.

SEWING MACHINE ATTACHMENT.—O. H. GENTRY, 796 Garson Ave., Rochester, N. Y. This invention has for its object to provide a spring balance device that may be attached to any sewing machine and so adjusted as to assist the operator, and which eliminates the danger of running the machine backwards when the operator ceases to apply the driving force, and the machine will be brought to rest by springs, without making a revolution either backward or forward.

TALKING MACHINE STOP.—H. E. DAKIN, 31 High Holborn, London, W. C., England. The invention relates to devices for automatically stopping a talking machine when the stylus reaches the end of the record. The object is to facilitate the setting or adjustment of the automatic stopping device prior to each operation, so that the turntable will be arrested immediately the record has been played, irrespective of the length of the record.

DISTRIBUTOR FOR SOWING MACHINES.—C. E. P. JULIEN, 41 Boulevard Haussmann, Paris, France. The invention is particularly characterized by a distributing plate, having a frustro-conical aperture controlled by a frame sliding between two other fixed plates, in order to bring successively the aperture of the sliding plate in alinement with those of the fixed plates, and thus effect the distributing of seed, in quantity determined by the capacity of the aperture of the sliding plate.

DISHWASHING MACHINE.—H. VAUDE VERE PUTMAN, 802 Campbell St., Schenectady, N. Y. An object of the invention is to provide a machine in which the dishes are constantly under water and wherein the cleaning is effected by creating a circulation of water so as to cause the latter to impinge upon the dishes at the most advantageous angle. A further purpose is to provide a machine in which the parts are removable to facilitate cleaning.

COMBINATION CRUSHER AND MILL.—H. LOEVEN, 860 16th St., Douglas, Ariz. One of the principal objects is to provide a mill having means for crushing, milling, classifying and screening, either wet or dry, ore or rock in one continuous operation. The mill comprises a rotatable drum, a screen surrounding the drum, in spaced relation thereto, and means connected with the drum and adapted to be actuated by the movement of the material within the drum for vibrating the screen.

PRINTING PRESS.—LA QUINNO RHOADES, 621 Bush St., Freemont, Ohio. The invention relates in general to inking mechanism for printing presses, and more particularly to a track and adjusting mechanism especially adapted for use with printing presses of the platen type. One of the principal objects is to provide tracks for the trucks or rolls of the inking rollers which are readily adjustable to compensate for wear or to adapt the inking mechanism to various sizes of forms.

PISTON FOR CONTROLLING FLUIDS UNDER PRESSURE.—A. P. LE BRON, 38 Rue de Berri, Paris, France. The invention relates to a fluid-tight movable partition or piston intended to separate two fluids under pressure without permitting these fluids to mix or lose in pressure. The result is obtained by interposed plastic packing between the members, the packing being engaged by portions of the piston members of less area than the area exposed to external pressure.

ROTARY PUMP.—F. N. IMHOFF, J. HUTCHINSON and C. C. HAMILTON, address Jos. Hutchinson, Gull Lake, Saskatchewan, Canada. This invention has for its object to provide a pump of the rotary type, comprising a rotor and a stator casing in which the rotor is mounted, the casing having inlet and discharge pipes for the fluid to be pumped. While the device is a rotary pump, it is also a motor, working with equal efficiency in either direction, as a pump or as a motor.

CLEANING DEVICE.—J. DI PIAZZA, 213 E. 107th St., New York, N. Y. The invention relates to a mechanical device particularly adapted to clean brushes. An object is the provision of an element of this nature in which all foreign matter will be effectively removed from the bristles of a brush. The device is simple in construction and requires but little force to thoroughly clean the bristles of a hairbrush.

AUTOMATIC STOP FOR TALKING MACHINES.—A. C. ILIFFE, Haileybury, Ontario, Canada. A purpose of the invention is to provide an electrically controlled stopping apparatus which is adjustable to effect the automatic stopping of a talking machine when the stylus has reached the inner end of the sound groove of the record, irrespective of the diameter of the record. The apparatus may be operated manually should it be desired to temporarily dispense with the automatic feature.

Medical Devices

APPARATUS FOR DRYING AND MEDICATING AIR.—C. DOBBS and A. E. PAINTER, address Albert E. Painter, Washoe County Bank Bldg., Reno, Nevada. This invention relates to an apparatus for dehydrating air and for adding to the same certain medicaments, disinfectants or the like. An object is to provide an apparatus wherein the air forced through said apparatus is treated to remove the moisture and other noxious ingredients, and to introduce certain curative and other beneficial and desirable properties for the treatment of diseases of the respiratory organs.

Musical Devices

PHONOGRAPH REPRODUCER.—W. WHITTEN, 4 Grosvenor Square, Schenectady, N. Y. One of the objects of the invention is to provide a phonograph reproducer for reproducing the mechanically recorded sound with a minimum of movable parts. A further object is to provide a reproducer which may be used for reproducing the sound both from disc and cylinder records.

RECORD LIFTER.—J. A. CLARK, 202 Main St., Vincennes, Ind. An important object of the invention is to provide a record lifter which is associated with the control of the phonograph whereby when the control is exercised to stop the rotation of the turntable the record lifter will be actuated to raise the record away from the turn-table and permit of the ready grasping and removal of the record.

SOUND POST.—J. W. MCGRATH, Brookhaven, Miss. The aim of the invention is to provide a sound post for violins which will enhance the resonancy of the tone of the instrument in that the vibration of the bass bar will be continued by means of the same for a much longer period. The device will serve to permit of more vibration being imparted to the essential parts of the instrument.

BANJO UKULELE.—R. A. CARLUCCI, 128 13th St., West New York, N. Y. The object of this invention is to provide an instrument of the banjo-ukulele type arranged to give the desired tension to the skin or parchment head and to insure proper sounding when played, also to permit of conveniently replacing an injured skin by a new one.

RECORD DISK FOR GRAPHOPHONES AND METHOD OF FORMING SAME.—H. PAKEMAN, 108 S. Fourth St., Vineland, N. J. The invention relates generally to record disks for graphophones, the purpose being to provide a construction whereby much greater effectiveness in sound is produced. The method consists of stamping a record disk as usual with a rim band around the sound groove, permitting the disk to harden, then cutting the rim away sufficiently to relieve pressure caused by its contraction during cooling.

Prime Movers and Their Accessories

OIL LEVEL INDICATOR.—H. G. MUELLER WEISS and B. E. BRAUN, c/o Thumb Accessory Co., Sebewaing, Mich. Among the objects of the invention is to provide means whereby the oil level cock on an internal combustion engine may be readily opened from the dashboard of the vehicle, and to provide an attachment capable of being applied during the course of manufacture or at any time thereafter without altering the construction of the vehicle.

FLYWHEEL.—V. W. PAGE, 309 Lafayette Street, New York, N. Y. One of the primary objects of this invention is to so construct a fly wheel that the same may be made of relatively non-resistant and soft material, and, at the same time, provide means for keying the fly wheel to the crank shaft of an internal combustion motor with a member of greater strength than the fly wheel material.

CONNECTING ROD GAUGE AND STRAIGHTENER.—F. W. NUERWELL, 307 W. 1st Street, Tulsa, Okla. The invention relates to gauges and straighteners especially adapted for use in connection with the connecting rods of internal combustion engines. An important object is to provide a gauge having means whereby it may be ascertained if the longitudinal axis of the wrist pin bearing or bushing is parallel to the longitudinal axis of the sectional bearing which receives the crank of the crank shaft, and whereby it may be readily ascertained if the rod is twisted or bent.

VALVE LIFTER GUIDE.—C. L. MAINLAND, 32 Husson Ave., Hollis, L. I., N. Y. The invention is especially designed for use in connection with the tapped valves of an internal combustion engine. A specific object is to provide in combination with the lifter guide of a valve, means which silences and prevents rattling, and means which automatically compensates for wear on both the reciprocating member and the guide, and to permit of replacement or repair when worn.

Miscellaneous Notes

The Largest Oil Pipe Line in the world, the only one to connect two oceans, will be laid by the Mexican government across the Isthmus of Tehauntepec.

The New York Curb Market, the second largest stock market in America, has deserted the curb and now transacts its business under a roof. It has just brought out an illustrated book descriptive of its functions, membership, and operations.

Servants Introduce New Problems.—In advertising for positions servants are now specifying the particular make of washing machine and vacuum cleaner they must have. Is the electrically-equipped kitchen to prove more of a boomerang than a blessing?

The Problem of the Spaniard's Foot.—Tradition has it that the first Spaniards to land on Hawaii were wrecked on the southeast coast in 1575; but the clear imprint of a Spanish shoe has been discovered in the surface of an ancient lava flow on the west coast near Honaunau, the "City of Refuge." Since the lava flow must antedate the building of the city in 1100, how the footprint got there is a mystery that will probably never be solved.

John Bull Loses.—A British Houdini offered $250 to the producer of any straitjacket from which he could not release himself. A certain John Bull invented a jacket and took up the challenge; but the performer, after successfully freeing himself, cut up the jacket and distributed pieces to the audience. Bull sued for $50 damages; the court, however, held that in a test of this kind the plaintiff must risk a damaged jacket, so John lost not only the jacket but the suit.

Legal Help in Foreign Trade.—The Division of Commercial Law of the Department of Commerce is compiling names of well-recommended foreign attorneys who are in a position to care properly for American interests. These names will not be published, but American firms in need of an attorney in any particular foreign locality may apply for and receive the necessary information. No responsibility is assumed either by the Bureau or by the sponsors for these attorneys.

Civics Without Textbooks.—Our larger cities have lately instituted a departure in the teaching of civics in elementary schools; textbooks are discarded and the outcome of several months' test is most encouraging. New York has instructed the children in 21 subjects, from the food of the city and the dispensation of public charities to the part of the citizen in government and the management of the schools. First-hand demonstrations have been given of the work of the fire department, and the "project method" sets the children to cleaning up and beautifying the school grounds. The benefits have already extended to entire communities.

Newsprint and Pulpwood.—It takes 40 years to grow pulpwood spruce, and our newspapers are using 3,000,000 cords of wood a year. The American Forestry Association suggests a plan by which 30,000 square miles of our cut-over lands, now unproductive, might be planted to 40 successive crops of timber; this would mean a perpetual supply of newsprint. With sound national forestry laws, the cooperation of the States, and active participation by the pulp and paper interests, our staggering fire loss would be held within reasonable limits, and the needful supply assured. Our yearly 2,000,000 tons of newsprint, in a ribbon the width of the daily paper, would extend 40,000,000 miles into space; only broad visioning and prompt action can save this gigantic industry from further disaster.

Advertising in the Far East.—The Japanese are irresistibly drawn to the artistic, and they are above all desirous of being thought alert and progressive. These apparently unrelated traits have influenced the trend of our advertising in Japan with beneficial results. The beautiful portrayal of a product by pictures touches the Japanese artistic sense, while continued repetition establishes the desirability of the product in his mind. In an appeal to Canadian manufacturers to "go and do likewise," the Trade Commissioner at Yokohama admits that United States' manufacturers understand advertising psychology better than almost any other country in the world, and pays high tribute to our success in Japan. By advancing our present high standards we may confidently hope that results will continue to justify the expense.

NEW STARRETT TOOLS

New Starrett Beveled Edge Squares: The line contact made by the beveled edge of these squares in contact with the work on which they are used is a feature that The L. S. Starrett Company believes will be much appreciated by many mechanics. With the exception of having beveled edges on both sides of the blades these No. 55 squares are similar to the well-known Starrett No. 20 Solid Steel Squares.

A further recent addition to the Starrett line of squares is the new *No. 140 Double Steel Square.* This square has a 4-inch sliding block graduated to 32nds and 64ths on one side and 8ths and 16ths on the other. Similar to the No. 14 Starrett Square but has larger beam.

Starrett T-Handle Tap Wrench: The handy tool for general use. Recommended for general use by tool makers, machinists and other mechanics. Especially designed for holding taps to be turned by hand, but can be used to equal advantage for holding drills, reamers, and other small tools. Jaws are designed to retain firm hold on tools and are heat-treated, insuring durability.

Another Starrett Vernier Height Gage is the new No. 454. 18-inch size with heavy base. Made in three types respectively graduated in English Measure, Metric Measure and both English and Metric Measures.

Starrett Protractor and Depth Gage No. 493: 6-inch sliding scale on protractor is graduated to 64ths and may be adjusted to gage any depth within capacity; it also may be swung on the protractor, enabling the user to conveniently lay off any angle within 180°. The L. S. Starrett Company believes this tool will become especially popular with draftsmen, machinists and shop foremen because of the convenience its use affords in laying out work.

At Last!—A Real Bench Block: At last mechanics are provided in the Starrett No. 129 Bench Block with a really suitable tool for facilitating the work of driving pins in round or flat work. The blade is a 3-inch disk, 1½ inches high, and has 9 holes varying from ⅛th inch to ⅝ths inch in size; also a V groove for holding round work.

Miscellaneous Notes

Negro Farmers.—There were 926,257 negro farmers in the United States January 1, 1920, according to the Bureau of the Census. In 1910 the number was 893,370.

Vesuvius Wakes Up.—The volcano celebrated last summer by displays of enormous smoke clouds. The demonstration is not thought to presage any serious eruption.

The Bones of Dante.—At the close of the Dante celebrations at Ravenna, fragments of the bones of the poet, stolen in 1865 but later recovered, were reunited to the skeleton.

Rescue Party Fails.—The party sent to find Knudsen and Tessen, who became separated from their comrades in the last Amundsen polar expedition, returned only to report failure.

Back to the Days of Barter.—A typewriter manufacturing company of Hartford, Conn., has sold a consignment of typewriters to the Russian Government, receiving payment in the form of sealskins and sables.

Automobile Aid for Mothers.—Ten towns near Cleveland, Ohio, had the benefit this summer of a baby clinic on wheels. A completely fitted truck in charge of physicians and trained nurses furnished this free service.

Flowers in a Block of Ice.—A wreath of Australian flowers, placed on the Cenotaph in Whitehall, London, by the Australian prime minister, made the long journey in a block of ice, and were quite fresh for the ceremony.

Human Hair as a Commodity.—Forty bales of human hair is one item of a cargo reaching Seattle from China. Each 133-pound bale is worth more than $400 here; our annual imports exceed $500,000, and most of the hair goes into hair nets.

National Parks and the Automobile.—Motor cars carried 600,000 persons through the Denver mountain park system in 1921. Motor visitors to Rocky Mountain National Park numbered 273,737, or 100,000 more than those attracted to the Yellowstone and Yosemite Parks put together.

Motor Fuel from Weeds.—Prof. Mailhe Toulouse believes that thousands of common weeds can be made to yield petrol containing large percentages of benzine and toluene. His process also produces a gas said to have developed 20,000 heat calories, which alone would pay for the necessary plant installation.

Heat Waves and Crime.—Apropos of the combined heat and crime wave in Paris, French psychologists are reviving the old theory that high temperature and crime go hand in hand. They instance the violence and cruelty of the Spaniard, ignoring facts that do not fit their theory. Why not look upon the tyrants and torturers of Siberia as natural products of the frigid air?

The Motorboat Garage.—Taking a hint from the automobile garage, floating garages for motor boats now sport sundry "free" signs, among them "Free electric bilge pump," "Free docking and rest rooms" and "Free use of hoist for residents." To Sheepshead Bay, Brooklyn, goes the credit for initiating these free services, which will doubtless prove not only popular but remunerative.

The Rubber Sponge and the High Flier.—The rubber sponge, now so commonly used in the bath, has been successfully adapted to other uses; it fills life preservers in place of the elusive air, and it provides soundproof telephone booths. Aviators are now defying the cold of high altitudes with rubber garments, among them a vest made from sponge rubber. Anyone who has worn a rubber coat on a warm day can testify that it retains the heat of the body while preventing any cool air from reaching it, and sponge rubber, with its air-filled interstices, combines warmth with lightness.

The Alps Yield Up the Dead.—The glaciers and snow fields melted so much during the long hot summer of 1921 that many long-lost bodies were found. One was that of a guide lost 18 years ago; another, a Swiss school teacher who disappeared in 1914; and inasmuch as the winter just past has been mild, it seems that many more bodies will be recovered this summer. It is hoped that the remains of Lord Frederick Douglas, killed during Whymper's ascent of the Matterhorn in 1865, may be found. Ice surpasses embalming, and if we could get to the bottom of the Arctic ice we might learn what men were like 50,000 years ago.

Electrical Notes

More Light with Less Current.—The old subject of keeping electric lamps and reflectors clean is again brought to our attention by Ward Harrison and J. R. Colville, in a recent issue of *Electrical Review and Industrial Engineer*. Among the items discussed by these authorities are the extent and causes of lighting depreciation, value of light wasted, and systematic maintenance. Experience has shown that in many factories more than 30 per cent of the light paid for is allowed to go to waste. One-half to two-thirds is being thrown away through lack of attention to simple maintenance requirements. In a plant where the entire time of one man is required the cost of cleaning open reflectors should not exceed 3 cents each.

Searchlight Carbons.—There is a whole field of scientific knowledge and room for experimentation in the matter of searchlight carbons. In an arc light the desire is, of course, for the highest possible brilliancy, and this brilliancy is obtained by light which emanates from incandescent particles, and since incandescence is a function of temperature, it is therefore necessary to use a material which will give the light source of maximum brightness. Since carbon has the highest melting point of all the common substances, it was natural to use this material for electrodes, especially since it has the advantage of leaving little residue unconsumed. The temperature of the crater of the positive electrode in the pure carbon arc is about 3700 degrees and gives a brilliancy of about 160 candlepower per square millimeter, continues *The Sperryscope*.

What Is the Power of Lightning?—Various estimates of the electrical power of lightning have been made from time to time, and we now add to our published collection the opinion of E. Poirson, as expressed in a recent issue of *Revue Generale de l'Electricite*. A cloud with a radius of 500 meters, states this French authority, situated 400 meters above the ground, represents a capacity of 0.055 mfd. The earth capacity is assumed to be 700 mfd. A bolt from this cloud to ground may have a potential of 50,000,000 volts. Assuming an air resistance of 10 ohms and the self-inductance of the rectilinear distance of 400 meters to be about 0.00075 henry, the frequency of such a discharge would be 24,700 cycles a second. A total of about 69,000,000 joules would be liberated in such a bolt, and, assuming a thousandth of a second as the time of discharge, this would equal 69,000,000 kilowatts.

A Novel Electrolytic Meter.—Much difficulty was experienced in Austria during and shortly after the war in obtaining a sufficient number of electric meters for new customers, according to *Zeitschrift fur Elektrotechnik and Maschinenbau*. A very simple and accurate meter was developed on the principle of the electrolytic meter. An iodine-mercury electrolyte is used between a mercury anode and a carbon cathode, both sealed into a glass vessel with an accurately calibrated measuring tube. The volume of this tube is so chosen as to be sufficient for one or two years, after which period the tube is reversed and emptied. The voltage drop of the meter is about one volt. Of course, the instrument is only an ampere-hour meter, but experience has shown that variations of the voltage settle quickly to the normal value and that, therefore, the absence of a voltage coil is not a serious drawback.

Steel-Aluminum Conductors.—In a recent issue of *Electrical World* it is shown that properly dimensioned steel-aluminum conductors—that is, stranded steel cable surrounded by one or more layers of aluminum wires—are mechanically superior and electrically equal to copper conductors, a fact which was recognized some time ago in America but was doubted in Germany. It is essential to use very pure aluminum, not less than 90 per cent, as otherwise heavy oxidizing will take place. The strength of the aluminum cable should be at least 85 or 90 per cent of the strength of the individual strands. The chief objections raised against a composition steel and aluminum cable were the electrolytic action between the two metals and the difference in the expansion coefficients. Practical experience showed that both objections were unfounded. Bessemer steel wires having a tensile strength of 120 kilograms per square millimeter are recommended for the steel core, and a double layer of aluminum wires should be used. The ratio of steel to aluminum should be for very important trunk lines 1 to 4, for secondary lines 1 to 6.

Electrical Notes

Electrically-Operated Silver Reclaiming Plants.—Owing to the high cost of chemicals in general and acids in particular throughout Europe, it has been found cheaper to reclaim silver out of the dust of mints, jewelers' refuse, and so on by the electrolytic process rather than by purely chemical methods. Using nitrate of silver as an electrolyte, a potential of one volt per cell and a current density of 250 amperes per square meter will give best results. Four cells are used in series, each containing six cathodes and fifteen anodes. To prevent the growth of silver deposit from the negative plates on the anodes, which would short-circuit the cell, the cathodes are enclosed in muslin bags and are, in addition, moved slowly backward and forward during the process.

Specifications for Lamps.—New specifications for large incandescent electric lamps have been issued by the Bureau of Standards. There have been some changes, an important one being the abandonment of the long-established provision that the light test of lamps shall be considered as ended when the candlepower has fallen to 80 per cent of the initial value. Because means have been found to prevent excessive blackening of tungsten lamp bulbs, the new tests are based on the total life of the time of burn-out. The standardization of lamps is on a smaller number of gradings, the tungsten schedule recognizing only the 5-volt steps in the 110-120 range, and the 10-volt steps in the 220-250-volt range. The publication of these specifications is now ready and may be obtained from the Bureau of Standards, Washington, D. C.

Safety Rule for Electric Welding.—Some simple rules are given in a recent issue of *Electrical World*, with regard to electric welding, as follows: 1. Goggles.—When more than one person is working in a booth, each must wear amber or blue goggles to protect his eyes from accidental flashes from adjacent arcs when his hood is off. 2. Hood.—Always wear a hood or use a shield with amber or blue-glass window for protection of the eyes and face against harmful ultra-violet and infra-red rays from the arc. 3. Clothing.—For protecting against burns from incandescent particles expelled from the arc, closely woven clothing, gauntlets and leather shoes having bellows tongues should be worn. 4. Cable.—Always have cable above the ground so that it will not be stepped on. On scaffold or platform work run the cable under the platform so that it will not be tripped over. 5. Ground.—Be sure the material to be welded is properly grounded before starting to weld. 6.—Scaffold Work.—When working on a scaffold be sure that hot electrode stubs or drops of hot metal will not fall on persons below the scaffold. 7. Footing.—Be sure you have a substantial footing before starting the weld. 8. Ventilation.—There must always be sufficient ventilation in the booth to keep it clear of fumes. 9. Welding Booths.—Welding must be done in a booth inclosed on three sides to prevent injury to persons working in the vicinity.

Supersensitive Electrical Instruments.—At the Annual Exhibition of the Physical Society of London a number of interesting electrical instruments were shown, not the least interesting being a string electrometer. As is well known, the string electrometer originally suggested by Professor Einthoven is an instrument in which the moving system is a silvered quartz fiber tightly stretched between, and parallel to, fixed metal plates. The special feature of a recent model is its compactness and the case with which it can be assembled with any other apparatus. In particular, being flat, this model may be used on a microscope stage without further fittings. The instrument consists of a silvered quartz fiber, each end of which is carried by a fing, which is anchored to an amber block by means of a brass clip. One flag is held in a slot in each clip by a screw. This enables the interchange of fibers to be done simply, as fibers can be supplied ready mounted on flags, and can be transferred by means of a fiber manipulator. The ends of the fiber are mounted on an invar steel rod, so that variations of temperature have only a small effect on the tension of the quartz fiber. Observation of the fiber is made through a microscope, with a finely adjustable forward and lateral movement. The instrument is extremely rapid in action, the free period being small. If desired, it can be employed as an oscillograph electrometer. It is sensitive, with a very small capacity, and the sensitiveness can be readily varied.

Mechanical Engineering Notes

Hexagon Nuts.—A new machine for producing these with a mere 10 per cent waste, in place of the 50-60 per cent heretofore lost, is announced. This result is achieved by the use of indenters which indent the bar between each pair of nuts-to-be, thus eliminating side-scrap.

Submerged Drilling.—One way to apply the coolant in drilling is by spray, drip, or analogous methods. Another is to have the entire operation conducted while tool and work are submerged in the fluid. There are specific advantages here: higher efficiency and less grinding, chips are kept from sticking to the drill and stock by the continuous circulation of the lubricant, etc. In many cases it seems as though this idea would be worthy of a trial.

Improving the Lubrication. — We watched a garage mechanic the other day drill a hole of one-eighth or three-sixteenths inch diameter through the hub of each connecting rod, clear through from outside to inside, in order to improve upon the results of splash-circulation of oil and make sure that the actual bearing surface between the rod and the crank-shaft throw should get its fair share of oil. It seems as though a judicious application of this remedy for faulty lubrication—always with due consideration whether it would lead to structural weakness of the part in question—might be profitable in ordinary machine practice.

Machines for Blind Operators.—German practice in breaking in blinded soldiers on machine and tool work has emphasized the fact that the blind operator is in considerably more danger of inadvertently engaging his free hand with the machine than the seeing worker. The difficulty has been met in ingenious fashion—by robbing him of the free hand. Machines for operation by the blind men are now designed especially for this purpose, and in such a fashion that the operator is forced to exercise a two-handed control. Both his hands are continually on the handles and levers—and he is therefore in no danger of getting one of them in the path of a tool.

Care of Punches.—The breakage of punches is not infrequently caused by their being adjusted so that the finer ones, projecting further than the heavier ones, make contact with the metal first. The setter, who is often made responsible for the adjustment of punches, should be sure and see that the heavier ones project further than the finer ones, in order that by entering the metal first they may take the brunt of the shock. Distortion of punches is liable to occur when particles of dirt or small cuttings are allowed to get in among the pieces to be punched. Such foreign matter prevents the metal from lying flat on the die, resulting in the punches descending on an inclined instead of perpendicular face. Punches require grinding when stampings begin to show rough or jagged edges. Sometimes the same fault is due to bad setting of the tools, the punch gradually shearing away the die until it becomes a loose fit, and thereby fails to produce good stampings.—*Practical Engineer.*

Chain-Driven Machine Tools.—The chain drive so largely used in the automobile world possesses advantages over the belt drive which engineers are bound to admit, says H. Bentley in *Engineering and Industrial Management.* It is positive—that is, there is no slip. A belt must be continually attended to, to keep a high efficiency. The correct range and graduation of speeds is obtained (not 2 or 3 per cent of slip), so that the maximum output is possible. Shafts may be driven at short centers more effectively by chain than by belting. Sometimes a crossed belt is employed to get a larger angle of lap and to surmount the short-center difficulty, but this requires constant attention, and is not so efficient as the chain. Frequently a motor is mounted on a foundation plate on the floor in order to obtain sufficient length of belt drive to the line shaft, where, if a chain is used, the motor may be carried on brackets close to the line shaft and the floor space saved. On account of the strength of the chain drive it is possible to get the whole arrangement in very little space. As no initial tension is required with a chain, the chain can run slacker than a belt, and journal friction is reduced to a minimum. The flexibility and silence when running are other useful features. It is possible to run at very high speed when the chain is enclosed in an oil bath.

Patent and Trade-Mark Notes

Apparatus and Method Claims.—In ex parte Sweetland (297 O.G., 397), the Commissioner of Patents has made the following rulings: Where a patent with apparatus claims drawn in generic terms has been granted, method claims which are substantially co-extensive with the apparatus claims of the patent should not be allowed to the same party in an application filed subsequently to the issue of the patent. If the steps of the method are such that the apparatus or its equivalent recited in claims of the patent must be present in order to carry out the alleged method, the latter is but the function of the apparatus.

Trademarks in Uruguay.—According to the trademark law of Uruguay the registration of a trademark creates proprietorship in and constitutes the title deed of a given mark, but without prejudice to the above, persons who may have in the country a trademark in use which is not registered, or the registration of which has lapsed, may challenge the registration of the same mark by a third party. If the third party has effected the registration and obtained legal protection, the other party may apply to the Government to have the registration detrimental to his previous right of use annulled. This may be done within two years from the date of the inscription challenged. While trademark piracy is not so common as in those countries where registration constitutes undisputable ownership, it is recommended that application for registration be made before shipping branded articles to Uruguay.

Commercial Success as Indicative of Invention.—While it is true that marked commercial success and public approbation of a patented invention are sometimes of importance in determining the question of invention, the doctrine involved is subject to exceptions. The United States Circuit Court of Appeals for the Second Circuit, in a recent decision (Boston Pencil Pointer Company vs. Automatic Pencil Sharpener Company, 276 F., 910), distinctly points out such an exception. The Court said, in effect, first, that commercial success is an unsafe guide to invention unless prior efforts to fill the want are shown, and, secondly, that articles may be new in a commercial sense, when they are not new in the sense of the patent law, and novelty, however great, can never be put in place of invention. The fact that a patented device has had enormous sales does not dispense with all other evidence of invention.

Substitution.—A manufacturer or dealer cannot substitute the merchandise of one where the merchandise of another is ordered, without informing the purchaser of that fact. In Samuel Brothers & Co. vs. Hostetter & Co., 118 F. 258, it was held sufficient to support a finding that the defendant was engaged in unfair competition, although there was no proof of any customer having actually been deceived, on the testimony of two witnesses employed by the complainant. These witnesses testified that they had gone to the wholesale liquor store of the defendant, where there had been sold to them by a clerk what was represented to them to be complainant's bitters, but which, in fact, was a spurious article made to imitate that of complainant's in appearance, taste and smell, and they were also furnished by the clerk with empty bottles having thereon complainant's label and trademark to be used in retailing the bitters to customers.

United Shoe Machinery Corporation Patent Leases.—The Supreme Court of the United States, on April 17, 1922, rendered its decision in reviewing a Decree of the Federal Court of the Eastern District of Missouri, involving the leases of the United Shoe Machinery Corporation, under the terms of which that company leased its patented machines to users thereof. The Decree of the Missouri Court was sustained by the Supreme Court. This Decree enjoined the use, first, of the restrictive clause which provided that the leased machine should not be used in the manufacture of shoes on which certain operations had been carried out by machines other than those provided by the corporation; secondly, the clause, that if the lessee failed to use certain kinds of machinery made by the corporation the latter had the right to cancel the lease of all machines; thirdly the clause which compelled the lessee to purchase all supplies from the corporation; fourthly, the clause which compelled the lessee to use the corporation's machines on shoes worked on by other machines of the corporation; fifthly, that if the lessee failed to lease all additional

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machinery from the corporation the latter would have the right to remove the machines already employed; sixthly, the provision for a payment of royalty on shoes made on the corporation machines; and seventhly, a preferential clause which specified lower royalties for lessees who agreed not to use certain machinery on shoes lasted on machines that were not corporation equipment.

Brazilian Trade-Mark Registrations.—Although the United States is not a member of the Berne Trade-Mark Convention, nevertheless our exporters will be interested in the recent decision handed down by the Supreme Court of Brazil, in which it was held that international registrations at Berne are not effective in Brazil. While Brazil is a member of the Berne Trade-Mark Convention, it has been held that the failure to publish the trade-mark in Brazil is fatal. This requirement with reference to publication applies to all trade-marks, and all classes of registrations whether an independent Brazilian application is filed or whether an attempt is made to protect a trade-mark through a Berne Convention registration or a registration under the Pan-American Convention. No arrangements have been made for the publication of trade-mark applications except in cases where independent Brazilian applications are filed, and in view of the ruling which has been made and other rulings which may follow, it is important that every trade-mark which is of value in the Brazilian market be protected by an independent registration in that country.

Corporate Names.—It is well settled that one corporation cannot adopt and use the name of another corporation in the same line of business. Furthermore, a corporation cannot use as part of its corporate title the trademark or trade name of another earlier in the field, nor can anyone use as a trademark for the same line of business the title or part thereof of a corporation or firm. In Rubber & Celluloid Harness & Trimming Company vs. The Rubberbound Brush Company, 88 A. 210, it was held that the use of the words "Rubber Bound" in defendant's corporate name was in contravention of plaintiff's rights in the term "Rubber Set," as applied to its merchandise. In Martell vs. St. Francis Hotel Company, 98 P. 1116, it was held that the defendant would be enjoined from conducting its hotel under the same name as that of plaintiffs, in the same neighborhood, and previously established, such use resulting in confusion and injury to the hotels and the public; and this, though defendant's hotel was larger and more expensive, and catered more to a transient trade, while that of plaintiffs, though patronizing transients, was more of a family hotel.

The Stanley Bill.—The Stanley Bill, which has been introduced in the Senate, and which contemplates the making of a very drastic change in our existing patent law, has aroused a great deal of interest, and much argument pro and con. Briefly, the effect of the Bill is to include in our patent law a provision whereby unless within a reasonable time a patent is "worked," compulsory licenses thereunder may be granted. The law is advocated by the War Department, on military grounds, and in order to compel foreign nations and inventors to manufacture their inventions in this country, so that in case of war they would be at the service of this country. The Bill is also favored by certain manufacturers. In the main, however, opposition to the Bill is strong. The Executive Committee of the American Patent Law Association has taken a very definite stand in opposition, saying: "It strikes at the very heart of our patent system, in that it would destroy the exclusive right of the patentee to his invention. This is the distinguishing feature of the patent law of this country, that makes it superior to the law of any other country. For this reason, it would be equally bad for the public, the inventor and the manufacturer."

Taxi Cabs of Distinctive Color.—Justice Newburger of the Supreme Court of the State of New York, in recently granting a temporary injunction in favor of the American Yellow Taxi Operators, Inc., restrained the defendant "from using or employing, or operating for hire, taxi cabs designed or painted or colored in imitation or colorable simulation of plantiff's taxi cabs." And, also, "adopting, using or employing on taxi cabs any names, devices, finish, color or get-up, style or dress, calculated to be confused with or mistaken for taxi cabs of the plaintiff." "I know of no clearer case of attempting to mislead the public, as the defendant admits he has done," said Justice Newburger.

LIMITED COMMERCIAL (BROADCASTING) STATIONS

So numerous have been the inquiries received with regard to a list of radio-phone broadcasting stations that we have decided to publish a complete list of such stations, up to and including April 10th. As new stations are opened up for radio-phone broadcasting service, we shall endeavor to make mention of them in our future issues, thus keeping this list up to date.—THE EDITOR.

Call	Station	Entertainment	Market	Weather
WSY	Alabama Power Co., Brown-Marx Bldgs., Birmingham, Ala.	X	—	—
KHD	Aldrich Marble & Granite Co., The C. F., 1704 Tejon St. N., Colorado Spgs., Col.	—	—	X
KZM	Allen, Preston D., 13th and Harrison, Oakland, Calif..	X	—	—
KGO	Altadena Radio Laboratory, 2490 Maiden Lane, Altadena, Calif.	X	—	—
WGI	American Radio & Research Co., Medford Hillside, Mass.	X	—	—
KFI	Anthony, Earl C., Inc., 10th and Hope Sts., Los Angeles, Calif.	X	—	—
WMA	Arrow Radio Laboratories, 1127 Arrow Ave., Anderson, Ind.	X	—	—
KZY	Atlantic-Pacific Radio Supply Co., 6003 Ocean View Drive, Oakland, Calif.	X	—	—
WMB	Auburn Electrical Co., 57 Court St., Auburn, Me.	X	—	—
WOR	Bamberger, L., & Co., 131 Market St., Newark, N. J.	X	—	—
KNR	Beacon Light Co., The, 636 South Hill St., Los Angeles, Calif.	X	—	—
WEB	Benwood Co., Inc., The, 1110 Olive St., St. Louis, Mo.	X	—	—
KJS	Bible Institute of Los Angeles, Inc., 536 S. Hope St., Los Angeles, Calif.	X	—	—
KXS	Braun Corp., The, 363 New High St., Los Angeles, Calif.	X	—	—
WOE	Buckeye Radio Service Co., The, 569 S. Main St., Akron, O.	X	—	—
WDZ	Bush, James L., Star Store Bldg., Tuscola, Ill.	X	—	—
WPE	Central Radio Co., Inc., 575 Grand Ave., Kansas City, Mo.	X	—	—
WDM	Church of the Covenant, 18th and N Sts., N. W., Washington, D. C.	X	—	—
WBU	City of Chicago, LaSalle and Washington St., Chicago, Ill.	X	—	—
WRR	City of Dallas, Police and Fire Signal Dept., Dallas, Texas	X	—	X
WCN	Clark University, Worcester, Mass.	X	—	X
WMC	Columbia Radio Co., South Ave. at Indianola, Youngstown, O.	X	—	—
WAAH	Commonwealth Electric Co., Inc., 182-184 E. 6th St., St. Paul, Minn.	X	—	—
WIL	Continental Electric Supply Co., 808 9th St., N. W., Washington, D. C.	X	—	—
KZI	Cooper, Irving S., 2041 Argyle Ave., Los Angeles, Calif.	X	—	—
WEY	Cosradio Co., The, 1725 Fairmount Ave., Wichita, Kan.	X	—	X
WHK	Cox, Warren R., 1965 E. 66th St., Cleveland, O.	X	—	—
WLW	Crosley Mfg. Co., 3820 Cleralain Ave., Cincinnati, O.	X	—	—
WWB	Daily News Printing Co., The, 402 2d St., N. W., Canton, O.	X	—	—
WJX	DeForest Radio Telephone & Telegraph Co., 1391 Sedgwick Ave., New York City.	X	—	—
WWJ	Detroit News, The, 615 Lafayette St., Detroit, Mich.	X	X	X
KOP	Detroit Police Dept., Bethune and John R., Detroit, Mich.	Police information		
KFZ	Doerr-Mitchell Electric Co., 118 Lincoln St., Spokane, Wash.	X	—	—
WRK	Doron Bros. Electric Co., 329 No. "C," Hamilton, O.	X	—	—
KQV	Doubleday-Hill Electric Co., 719 Liberty Ave., Pittsburgh, Pa.	X	—	—
WMU	Doubleday-Hill Electric Co., Hall, Frank M., 415 Randolph St., N. W., Washington, D. C.	X	—	—
WHU	Duck, The Wm. B. Co., 224 Superior St., Toledo, O.	X	—	—
KLB	Dunn, J. J., & Co., 1295 E. Villa, Pasadena, Calif.	X	—	—
WAAJ	Eastern Radio Institute, 899 Boylston St., Boston, Mass.	X	—	—
WJT	Electric Equipment Co., 703 State St., Erie, Pa.	X	—	—
KGC	Electric Lighting Supply Co., 5118½ Harold Way, Hollywood, Calif.	X	—	—
KQT	Electric Power & Appliance Co., Inc., 17 No. 2d St., Yakima, Wash.	X	—	—
WPI	Electric Supply Co., 123 Market St., Clearfield, Pa.	X	—	—
KSL	Emporium, The, Market St., San Francisco, Calif.	X	—	—
WSX	Erie Radio Co., 117 W. 9th St., Erie, Pa.	X	—	—
KUO	Examiner Printing Co., The, San Francisco, Calif.	X	—	—
WPR	Federal Institute of Radio Telegraphy, 2d and Federal Sts., Camden, N. J.	X	—	—
WGR	Federal Telephone & Telegraph Co., 1738 Elmwood Ave., Buffalo, N. Y.	X	X	X
WPL	Fergus Electric Co., 524 Main St., Zanesville, O.	X	—	—

Call	Station	Entertainment	Market	Weather
WCE	Findley Electric Co., Inc., 212-216 So. 5th St., Minneapolis, Minn.	X	—	—
WPA	Fort Worth Record, Fort Worth, Texas	X	X	X
WWI	Ford Motor Co., Michigan Ave., Dearborn, Mich.	X	—	—
KFV	Foster-Bradbury Radio Store, Herald Block, Yakima, Wash.	X	—	—
WGY	General Electric Co., 1 River Road St., Schenectady, N.Y.	X	—	—
WCJ	Gilbert, The A. C. Co., 493 Blatchley Ave., New Haven, Conn.	X	—	—
WIP	Gimbel Bros. Dept. Store, Market St., at 9th., Philadelphia, Pa.	X	—	—
KJQ	Gould, C. O., 615 E. Main St., Stockton, Calif.	X	—	—
KGG	Hallock & Watson Radio Service, 192 Park St., Portland, Ore.	X	—	—
WLK	Hamilton Mfg. Co., 2011 Alabama, North, Indianapolis, Ind.	X	—	X
WOH	Hatfield Electric Co., 531 N. Meridian St., Indianapolis, Ind.	X	—	—
KYG	Hawley, Willard P., Jr., 400 E. 22d St., North, Portland, Ore.	X	—	—
KQW	Herrold, Charles D., 467 1st St., San Jose, Calif.	X	—	—
KVQ	Hobrect, J. C., 915 7th St., Sacramento, Calif.	X	—	—
KON	Holzwasser, Inc., 5th and Broadway, Los Angeles, Calif.	X	—	—
WJD	Howes, Richard Harris, Granville, O.	X	—	—
WGL	Howlett, Thomas F. J., 2303 N. Broad St., Philadelphia, Pa.	X	—	—
WSV	Hunter, Dr. L. M., and Carrington, G. L., 2420 Ixard St., Little Rock, Ark.	X	—	—
WEV	Hurlburt-Still Electrical Co., McKinney Ave. and San Jacinto St., Houston, Texas.	X	—	X
WGV	Interstate Electric Co., and New Orleans Item, 357 Barrone St., New Orleans, La.	X	—	—
WIK	K. & L. Electric Co., 427 Olive St., McKeesport, Pa.	X	—	—
WTG	Kansas State Agriculture College, Manhattan, Kan.	—	—	X
WOC	Karlowa Radio Co., 606 Best Bldg., Rock Island, Ill.	X	—	X
KLP	Kennedy, Colin B., Co., Inc., O'Keefe Ave., Los Altos, Calif.	X	—	—
KHJ	Kieruluff, C. R., & Co., 757 S. Los Angeles St., Los Angeles, Calif.	X	—	—
KQL	Kluge, Arno A., 1045 S. Bixel St., Los Angeles, Calif.	X	—	—
KJR	Kraft, Vincent I., 6838 19th Ave., N. E., Seattle, Wash.	X	—	—
KMC	Lindsay-Wearstler & Co., Reedley, Calif.	X	—	—
KGB	Lorden, Edwin L., 602 California St., San Francisco, Calif.	X	—	—
KMO	Love Electric Co. (H. C. Reichert), 818 North L St., Tacoma, Wash.	X	—	—
WWL	Loyola University, 6363 St. Charles Ave., New Orleans, La.	X	—	—
WDZ	Marshall-Gerkin Co., 27 Ontario St., Toledo, O.	X	X	X
KRE	Maxwell Electric Co., Claremont Hotel, Berkeley, Calif.	X	—	—
WBS	May, D. W., Inc., 178 Central Ave., Newark, N. J.	X	—	—
WTP	McBride, George M., 611 Midland St., Bay City, Mich.	X	—	—
WWT	McCarthy Bros. & Ford, 75 W. Mohawk St., Buffalo, N. Y.	X	—	—
WOU	Metropolitan Utilities District, 1802 and 3405 Farnum St., Omaha, Neb.	X	X	—
KYJ	Meyberg, Leo J., Co., 8th and Broadway, Los Angeles, Calif.	X	—	X
KDN	Meyberg, Leo. J., Co., Fairmont Hotel, San Francisco, Calif.	X	—	X
WAH	Midland Refining Co., 30 S. Main St., El Dorado, Kan.	—	X	X
WEH	Midland Refining Co., Tulsa, Okla.	—	X	X
WOS	Missouri State Marketing Bureau, Capitol Bldg., Jefferson City, Mo.	—	X	—
WGH	Montgomery Light & Water Power Co., Montgomery, Ala.	X	—	X
KGU	Mulrony, Marion A., Waikiki Beach, Honolulu, Hawaii.	X	—	—
WAAM	Nelson Co., I. R., Bond St., Newark, N. J.	X	—	—
KOB	New Mexico College of Agri. and Mech. Arts, State College, New Mexico	X	—	X
WPB	Newspaper Printing Co., Gazette Sq., Pittsburgh, Pa.	X	—	—
KLN	Noggle Electric Works, Alvarado St., Monterey, Calif.	X	—	—
KFC	Northern Radio & Electric Co., 418 Union St., Seattle, Wash.	X	—	—
KGN	Northwestern Radio Mfg. Co., 1556 E. Taylor St., Portland, Ore.	X	—	—
WAAL	Minnesota Tribune Co., 54 S. 4th St., Minneapolis, Minn.	X	—	—
WPG	Nushawg Poultry Farm, R. D. No. 2, New Lebanon, O.	X	—	—
WSL	O'Connor, Leon James, 26 Bank Pl., Utica, N. Y.	X	—	—
WKY	Oklahoma Radio Shop, 1911 W. Ash St., Oklahoma City, Okla.	X	—	X
KGW	Oregonian Publishing Co., 6th and Adler, Portland, Ore.	X	—	—
WOZ	Palladium Printing Co., Richmond, Ind.	X	X	X
WTK	Paris Radio Electric Co., 42 S. Main St., Paris, Texas.	X	—	—
WOK	Pine Bluff Co., The, Pine Bluff, Ark.	X	—	—
KGF	Pomona Fixture & Wiring Co., 310 W. 2d St., Pomona, Calif.	X	—	—
KWG	Portable Wireless Telephone Co., 530 E. Market St., Stockton, Calif.	X	—	—
WMH	Precision Equipment Co., 2437 Gilbert Ave., Cincinnati, O.	X	—	X
KFU	Precision Shop, The, Sycamore St., Gridley, Calif.	X	—	—
KSS	Prest & Dean Radio Research Laboratory, 18 Elm Ave., Long Beach, Calif.	X	—	—
KSD	Pulitzer Pub. Co. (The Post-Dispatch), 12th and Olive Sts., St. Louis, Mo.	X	—	—
WBAA	Purdue University, West Lafayette, Ind.	X	—	—
WDW	Radio Construction & Electric Co., 542 Irving St., Washington, D. C.	X	—	—
WDY	Radio Corp. of America, Roselle Park, N. J.	X	—	—
WAAO	Radio Service Co., 1019 Quarrier St., Charleston, W. Va.	X	—	—
KJJ	Radio Shop, The, 229 Sunnyvale Ave., Sunnyvale, Calif.	X	—	—
KNV	Radio Supply Co. of California, 815 S. Main St., Los Angeles, Calif.	X	—	—
KYY	Radio Telephone Shop, The, 175 Steuart St., San Francisco, Calif.	X	—	—
WGF	Register & Tribune, 715 Locust St., Des Moines, Iowa.	X	—	—
KLZ	Reynolds Radio Co., Inc., 1124 University St., Denver, Col.	X	X	X
WHN	Ridgewood Times Printing & Pub. Co., Inc., Chamber of Commerce Bldg., Ridgewood, N. Y.	X	—	—
WKN	Riechman Crosby Co., The, 223 S. Front St., Memphis, Tenn.	X	X	X
WFO	Rike Kumler Co., The, Main and 2d Sts., Dayton, O.	X	X	X
WHQ	Rochester Times Union, Inc., 22 Exchange St., Rochester, N. Y.	X	X	X
KNJ	Roswell Public Service Co., The, 112 W. 3d St., Roswell, N. M.	X	—	—
KGY	Ruth, Sebastion (St. Martin's College), Lacey, Washington	X	—	—
KJC	Standard Radio Co., 724 S. Broadway, Los Angeles, Calif.	X	—	—
WPJ	St. Joseph College, 18th and Thompson, Philadelphia, Pa.	X	—	—
WEW	St. Louis University, 221 Grand and Pine Sts., St. Louis, Mo.	—	X	X
KMJ	San Joaquin Light & Power Corp., Tulare and H Sts., Fresno, Calif.	X	—	—
WHW	Seeley, Stuart W., Weather Bureau Bldg., E. Lansing, Mich.	—	—	X
WJK	Service Radio Equipment Co., The, 225 Superior St., Toledo, Ohio	X	—	—
WSN	Ship Owners Radio Service, Inc., 519 Granby St., Norfolk, Va.	X	—	—
WDT	Ship Owners Radio Service, 80 Washington St., New York City	X	—	—
WNJ	Shotton Radio Mfg. Co., Inc., The, 8 Market St., Albany, N. Y.	X	—	—
KDPT	Southern Electrical Co., 3d and E. Sts., San Diego, Calif.	X	—	—
WBT	Southern Radio Corp., 905 Realty Bldg., Charlotte, N. C.	X	X	X
WCK	Stix-Baer-Fuller, Washington St., St. Louis, Mo.	X	—	—
WFI	Strawbridge & Clothier, 8th and Market, Philadelphia, Pa.	X	—	—
KQY	Stubbs Electric Co., 75 6th St., Portland, Ore.	X	—	—
WBL	T & H Radio Co., (P. G. Thurman), 401 S. Anthony St., Anthony, Kan.	X	—	—
WRW	Tarrytown Radio Research Lab., 21-23 N. Broadway, Tarrytown, N. Y.	X	—	—
WGU	The Fair, State, Adams and Dearborn Sts., Chicago, Ill.	X	—	—
WRL	Union College, Schenectady, N. Y.	X	—	—
WAAF	Union Stock Yard and Transit Co., Chicago, Ill.	X	X	—
WPO	United Equipment Co., 600 Monroe St., Memphis, Tenn.	X	—	—
WRM	University of Illinois, Urbana, Illinois	X	—	—
WLB	University of Minnesota, Minneapolis, Minn.	X	X	X
WCM	University of Texas, Austin, Texas	X	X	—
WHA	University of Wisconsin, No. Charter, Madison, Wisconsin	X	X	X
WOO	Wanamaker, John, 13th and Market, Philadelphia, Pa.	X	—	—
KLS	Warner Bros., 2201 Telegraph Ave., Oakland, Calif.	X	—	—
KHQ	Wasmer, Louis, 419 13th Ave., N. Seattle, Wash.	X	—	—
WOQ	Western Radio Co., Kansas City, Mo.	X	X	X
KOG	Western Radio Electric Co., 7th and Grand Sts., Los Angeles, Calif.	X	—	—
KYW	Westinghouse Electric & Mfg. Co., 72 W. Adams St., Chicago, Ill.	X	X	X
KDKA	Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.	X	—	—
WJZ	Westinghouse Electric & Mfg. Co., 95 Orange St., Newark, N. J.	X	—	—

CLASSIFIED ADVERTISEMENTS

The Market Place for the Small Advertiser

Rate for advertising in this section 15 cents per word, for each insertion, payable in advance. Minimum space acceptable, 20 words. Rate card giving discounts for number of insertions sent on request. Advertisements for insertion in the August issue should be in our office by June 20th.

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ADDING or calculating machines. Free trial. Money back guarantee. Connell and Shattuck, 422 Fourth Ave., Pittsburgh, Pa.

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AGENTS, 600% profit. Free sample. Lowest priced Gold and Silver Sign Letters for stores, offices, automobiles. Large demand. No experience necessary. $50 to $200 a week easy. Exclusive territory. Acme Letter Co., 2800 A Congress St., Chicago.

136 LETTER AUTO INITIALING OUTFIT $1.50 postpaid. Apply 25 each — make $32.50. Samples free. Monogram Initial Co., D 10, Westwood, N. J.

SELL Perfume Blocks, one 50c block perfumes entire rooms, clothes closets, lavatories, trunks, enclosed automobiles, etc. Lasts months; 100 per cent profit; territory protection. International Chemical Co., Box 174R, Cleveland, Ohio.

BIG MONEY AND FAST SALES—Every owner buys Gold Initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 197, East Orange, N. J.

GUARANTEED HOSIERY, lowest prices, manufacturer's complete line direct to wearer. Samples without charge. We deliver. Part time acceptable. Joseph Bros., 337-J, Broadway, New York.

AGENTS. Here's big money—and independence. $2.50 invested nets $28.25 profit; $5.00 nets $83.00. Apply initials to side doors of autos. Every car owner a prospect. Transfer Monogram Co., Inc., Dept. A., 10 Orchard St., Newark, N. J.

TEMPERED COPPER? 80% Copper Chisel. Cuts Steel. Unaffected by Heat. Big Seller. Send 25c for Agent's Sample and Full Particulars. Wm. J. Eberle, A. M. & M. Bank Bldg., Milwaukee, Wis.

WANTED. Your spare or full time. Guaranteed line of soaps, toilet articles, household specialties. Repeat sales assured. 100% profit. 150 articles. Exclusive territory. Free sample case offer. Write at once. Ho-Ro-Co. Mfg. Co., 182 Locust St., St. Louis, Missouri.

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MANUSCRIPTS WANTED; stories, poems, plays, etc. Cash or royalty. Make money spare time. Copyrighted. Instruction Book for Writers Free. Submit Mss. or write Literary Bureau, 526, Hannibal, Mo.

AMERICAN MADE METAL TOYS AND NOVELTIES

MANUFACTURERS WANTED on large or small scale, for production of metal toys and novelties. Toy soldiers, cannons, machine guns, cowboys, Indians, wild animals, whistles, bird whistles, race horses, baseball players, paper weights, match holders, automobile ornaments, souvenirs, advertising specialties, and hundreds of other things. No experience or tools necessary. Hundreds and thousands made complete per hour. Bronze casting forms furnished to manufacturers complete with outfit from $5.00 up. We buy these goods all year, paying fixed prices. Contract orders placed with manufacturers. An enormous business is offered to industrious men this year with an excellent opportunity to enter this open field. Write us only if you mean strictly business. Catalog and information free. Metal Cast Products Company, 1696 Boston Road, New York.

AUTOMOBILE ACCESSORIES

DRIVE 100 tacks and save $25. We tailor Auto Top Recoverings for all cars. Ford $5.20 and up. Other cars $14 and $16 with Plate Glass Lights. Catalog, samples free. Equipment Co., 55 Canal, Cincinnati, Ohio.

AN old worn out Ford runs like a 12 Cylinder when fitted with Pecks Transformers and Testers. Regular price $2 for 4. Special price to Scientific American readers, 50 cents for 4. Valve Timing Chart sent free with each set. Peck, 2154 N. Carlisle St., Philadelphia.

AUTOMOBILE OWNERS

FORD Car Repair Book sent free. This complete, well illustrated, valuable book explains in a simple way the Causes and Cures of Over-heating; Repairing Ford Timer; Curing Piston Ring Troubles; Carburetor Adjustments and Repairs; Connecting Rods; Transmission Troubles; Care and Repair of Rear Axle; Stopping Axle Grease Leaks; also covers practically every other phase of Ford Car Repairing. Send 25c coin for three months' trial subscription and get the valuable repair book free. Ford Owner and Dealer Magazine, 302 Montgomery Bldg., Milwaukee, Wis.

AUTOMOBILE OWNERS — Garagemen — Mechanics—Repairmen—send for free copy of this month's issue. It contains helpful, instructive information on overhauling, ignition troubles, wiring, carburetors, storage batteries, etc. Over 140 pages, illustrated. Send for free copy today. Automobile Digest, 542 Butler Bldg., Cincinnati.

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YOU CAN have a business profession of your own and earn big income in service fees. A new system of foot correction; readily learned by anyone at home in a few weeks. Easy terms for training; openings everywhere with all the trade you can attend to. No capital required or goods to buy; no agency or soliciting. Address Stephenson Laboratories, 23 Back Bay, Boston, Mass.

PROFITABLE sales by mail! Circularize newly compiled mailing lists 15,000,000 classified names. Example: 200,000 wealthy rural mail order buyers; 3,000,000 farmers (by states) $6.00 thousand. Responsible firm's offer. You'll want more. Lo Martinek Co., Corona, New York. No duplicates.

"SCHEMER MAGAZINE," Alliance, Ohio. 40-page monthly, prints big profit schemes; one subscriber making $25,000 from three, another $10,000 from one. Try your luck. Year, only $1.00; three months, 25c. None free.

BUSINESS OPPORTUNITY

BECOME MASTER DEALER.—Learn secrets real estate success. Amazing profits, independence. Develop natural ability. Operate on own book. Either sex. Guaranteed. Special offer free.—Stephens Realtor System, Wysor Bldg., Muncie, Ind.

RESPONSIBLE corporation wants general sales managers to open branch office, manage salesmen. $500 to $5000 necessary; expenses to Baltimore allowed if you qualify. Address Manager, 603 N. Eutaw Street, Baltimore, Md.

EXECUTIVES WANTED

ACCOUNTANTS and other office men of proven ability seeking positions, find our service extremely satisfactory. Our Mr. H. H. Harrison can confidently negotiate for you suitable connections, as he has successfully done for thousands of others since 1909. Inquiries invited. The National Business Bourse, Inc., Association Bldg., Chicago.

EXPERIMENTAL RUBBER WORK

WE DO experimental compounding, vulcanizing, testing; chemical analyses; develop your rubber ideas, processes, inventions. Let us advise you. Consult us. Kent Rubber Laboratory, Consulting Engineering Chemists, Box 196, Kent, Ohio.

FOR INVENTORS

INVENTOR and Manufacturer: Let us be your machine shop. We make models, build special machinery tools, dies and manufacturing. We have a modern daylight factory with precision machinery. Send blue prints or sketches for estimate. Victor Engineering & Mfg. Co., 2524 W. Chicago Ave., Chicago, Ill.

WE make working models for inventors and do experimental metal work and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Ill.

"The fact that our advertisement has been in each consecutive issue of SCIENTIFIC AMERICAN's classified column should be ample proof of the results that we have obtained. We consider this publication one of the best mediums for advertising our particular line and we must say candidly that we are very well pleased with the results obtained so far."

Quoted from a letter in our files which tells the whole story.

FOR INVENTORS

PATENTS. If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its action. All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to Patents, Trade Marks, Foreign Patents, etc. "Scientific American" contains Patent Office Notes. Decisions of interest to inventors, and particulars of recently patented inventions. Munn & Co., Solicitors of Patents, 626 Woolworth Bldg., New York; Scientific American Bldg., Washington, D. C.; 801 Tower Bldg., Chicago, Ill.; Hanna Bldg., Cleveland; Hobart Bldg., 582 Market St., San Francisco, Calif.

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MODEL Steam Engines, Boilers, Electric and Steam Boats, Yachts, Model Ship's Fittings and Model Makers' supplies. Send 20c for new large illustrated catalogue and handbook. Bathe Mfg. Co., Dept. G, 5214 Woodland Ave., Philadelphia.

DON'T buy a Bicycle Motor Attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. SA, Galesburg, Kans.

HELP WANTED

RELIABLE HELP WANTED to learn "Tangography Art Painting," and establish branch at your home. Genuine offer; opportunity for permanent business. No experience necessary, learn quickly. Free booklet, act quick. Tangley Company, 166 Main, Muscatine, Iowa.

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DOUBLE Entry Bookkeeping mastered in 60 hours with 8 keys; guaranteed; diplomas. Beginner bookkeepers, attention! Trial balances and Financial statements learned in one hour. International Bookkeeping Institute, Dept. 25, Springfield, Mo.

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YOU can make 50 to 100 copies of a letter, notice, etc., on three cents worth of Heyer Quality compound. Write for free catalog and samples. The Heyer Duplicator Co., 158 No. Wells St., Chicago.

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FREE! Sectional Loose Leaf Postage Stamp Album at the rate of 8 pages each month given with subscription to our monthly Journal. Send two-cent stamp for prospectus. United Stamp Co., 140 S. Dearborn St., Chicago, Ill., Dept. S.

STAMPS — 50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., 10c; 50 different U. S., 25c; 1,000 hinges, 10c; 1,000 mixed, 40c. List free C. Stegman, 5952 Cote Brilliante, St. Louis, Mo.

PERSONAL

EXCHANGE cheery letters with new friends! Lots of fun! Send stamped envelope for information of our exchange plan. Betty Lee, 28 East Bay Street, Suite 19, Jacksonville, Florida.

PRINTING

4 Reams Full Size Letterheads, Howard Bond—$10. 8 Reams—$16.50. White or colors, No. 20. Envelopes 6¾ match, same prices. Note, delivery prepaid. Our great variety of type assures you of distinctive letterhead. Letterhead Press, 1451 Broadway, New York.

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WORLD-ROMIC SYSTEM, MASTERKEY to All Languages. Six Textbooks, $1.75. French Chart, 37c Spanish Chart, 37c; Speech-Organs Chart, 37c. Pronunciation-Tables, 77 Languages, 30c each. Languages Publishing Co., 8 W. 40th St., New York.

LETTER SPECIALIST

The better the letter—the greater the returns. I can improve any letter, folder, or sales literature that you send me. You be the judge. To get maximum results submit your campaign for improvement to Wilson, 247 William St., East Orange, N. J.

MAIL ORDER METHODS

$30 A WEEK, evenings home—I made it. Sample article and plan 25c. Booklet for stamp tells how also you can earn $19 a hundred stamping names on key checks. Sample and instructions 25c. Alacts Scott, Cohoes, N. Y.

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VIOLINS.—Deep, Mellow, Soulful—on easy credit terms. High-grade, wonderful instruments of my own make. Development of many years' expertness. Write for book. Gustav W. Henning, 2424 Gaylord Street, Denver, Colo.

MISCELLANEOUS

HYPNOTISM—Banishes disease; controls others; astounding exhibitions possible. 25 easy lessons $1.00. "Mind-reading" (any distance); simply wonderful, wonderfully simple, 30c. Satisfaction guaranteed. Book Catalog and "Hypnotic Wonders" free. Science Institute, SA 1014 Belmont, Chicago.

RADIO

BUILD RADIO SETS. We supply parts or complete units. Catalog 15 cents. Easily understood assembly drawings, Audion Detector, Crystal Detector Set, Non-regenerative Receiver, Regenerative Receiver, 2 Step Amplifier 25 cents each. All five $1.00. No stamps accepted. Hatfield Airfone Company, Dept. F, Owego, N. Y.

THE HOME RADIO—How to make and use it. At last! A simple explanation of the making and use of a home radio outfit. Every step in construction is carefully directed and illustrated with numerous working diagrams. Bound in cloth. Postpaid for 75c. Radio Educational Service, 200a-5th Ave., R 416. N. Y. C.

"RADIO FOR EVERYBODY"—352 pages profusely illustrated with an accurate description of all types of receiving sets and wiring diagrams adaptable to your particular location, with instructions of how to make them. Written by an authority on radio in plain understandable English. Gives the rudiments of radio for beginners and hook-ups for the advanced. Bound in cloth $1.60 postpaid. Dept. C, Box 773 City Hall Station, New York City.

BUILD your own Radio Receiver with blue prints which show full constructional data, wiring diagram, etc. Superior apparatus at less than half the cost of finished products. Ask for Bulletin 449. Experimenters Information Service, 45 Pinehurst Ave., New York City.

TELEGRAPHY both Morse and Wireless taught thoroughly. Big salaries. Tremendous demand for wireless operators. Oldest and largest school. All expenses low—can earn large part. Catalog free. Dodge's Institute, Vail St., Valparaiso, Indiana.

SCIENTIFIC INFORMATION

SUCCESS or Failure? Which is your destiny? Scientific information. "Success" pointers and Personality sketch for 10c and birthdate. Thomson-Heywood, Dept. 85, Chronicle Bldg., San Francisco, Cal.

TO PIPE SMOKERS

I WANT to send Free to every chronic pipe smoker in the country a good, big, generous sample package of my pure, sun-cured, nature-flavored Old Green River Pipe Tobacco. No money to pay. If you are a tobacco crank, all the better. Try the pure stuff. No syrup, flavoring or dope. After you try it free, I'll show you how to cut your smoke bill one-half and get more pipe joy. Just send name and address, and say whether you want mild, medium or strong. Pete Moberly, Box 897, Owensboro, Ky.

WANTED

AMBITIOUS MEN: $40.00, $150.00 weekly. Become advertising writers. Students frequently earn $20.00, $40.00 weekly while learning. Prepare quickly at home spare time. We assist you to position. Write Applied Arts Institute, Dept. 298, Witherspoon Bldg., Philadelphia.

MANUFACTURER to buy outright or on royalty basis, a patented baking device for gas or oil cook stoves. Bakes on one burner quicker than oven with less heat and won't scorch food. C. C. Gross, Box 63, Langhorne, Bucks Co., Pa.

Call	Station	Entertainment	Market Weather
WBZ	Westinghouse Electric & Mfg. Co., 625 Page Bldg., Springfield, Mass.	X	— —
WHD	West Virginia University, Morgantown, West Va.	X	— —
WJH	White & Boyer, 812 13th St., N. W., Washington, D. C.	X	— —
WPM	Williams, Inc., Thomas J., 1324 New York Ave., Washington, D. C.	X	— —
WNO	Wireless Telephone Co. of Hudson County, 997 Bergen Ave., Jersey City, N. J.	X	— —
KOA	Y.M.C.A., 16th Ave. and Lincoln St., Denver, Colo.	—	— I
WKC	Zamoiski, Jos. M., Co., 2527 Madison Ave., Baltimore, Md.	X	— —

April 10, 1922— 167 Stations

Radio Notes

Radio Service for Fishing Fleet.—Word comes from France to the effect that radio equipment ranging from 250 watts to 1,000 watts capacity is to be installed on more than 200 French fishing schooners. In 1918 there were only 30 fishing boats thus equipped.

Railroad Radio.—While there is nothing fundamentally new to the use of radio on board trains, the fact remains that with the present development of the art the application becomes practical at last. Tests have recently been conducted by the Delaware, Lackawanna & Western Railroad. As this issue goes to press we have just succeeded in obtaining photographs and complete information of the interesting installation aboard the train and the results obtained. The complete facts will appear in our July issue.

Destruction of Princeton's Radio Station.—A disastrous fire in one of the buildings of the Princeton University recently destroyed a part of the radio equipment. While the loss was amply covered by insurance, it was an unfortunate accident since the matter of arranging for a broadcasting service was just about completed. The idea of a broadcasting originated with Mr. L. S. Gatter (1912) and was taken up at once by those in charge of the station. The University of Wisconsin and the University of Minnesota already have established broadcasting stations for general university news, as well as for results of athletic contests. The set to be installed will having a sending range of 1,000 miles and will operate in 300-meter wave length.

An Automatic S.O.S. Signal.—Interesting progress has been made in England in the way of developing an automatic device for sending out S.O.S. or distress signals at sea. Instead of using the usual telegraph key and sending out the S.O.S. call, the system is to send out by means of an automatic device a dash of a certain length at regular intervals. Such signals serve to operate an alarm bell on other ships within range, and the operator of the ship in distress can then send specific instructions. The important advantage of the new system is that its signals do not conflict with other radio signals, and that it rings an alarm bell on ships in the immediate vicinity. Ten ships are already equipped with the new signaling device and 25 more are being so equipped. Satisfactory results have been obtained over a radius of 100 miles.

A Filter for Radio.—Although much has been said and written about the remarkable filters employed by the telephone lines and by advanced radio workers for the separation of telephone and telegraph messages, it has remained for Dr. Frank B. Jewett, chief engineer of the Western Electric Company, to demonstrate how the filter permits of transmitting radio telephone and telegraph messages simultaneously, and of separating these messages at the receiving end, at a recent meeting of the American Institute of Electrical Engineers. The present electrical filter is the invention of Dr. G. A. Campbell, a telephone engineer, and makes it possible to separate the various frequencies at which the individual telephone and telegraph messages are carried. The detected electrical current in a radio receiving set is passed through the filter which separates the frequencies of the telegraph message from those of the telephone. The filter differs materially from the ordinary tuned circuits familiar to the radio enthusiast, since it separates not single frequencies but bands of frequencies of any predetermined width. The filter makes it possible to separate the band of frequencies comprising the telephone message from the band comprising the telegraph message. It can also separate one telephone message from another.

Civil Engineering Notes

A Record Train? A train drawn by a single engine recently brought 165,000 bushels of grain over the Canadian Pacific lines. The train was 0.9 mile long, consisting of 110 loaded cars, a water car, and a caboose. The gross weight was 686,000 tons.

The Effect of Temperature on the Rate of Corrosion is practically an unknown quantity. But experiments have shown that at 80 degrees Centigrade iron corrodes nearly ten times as rapidly as at 0 degrees. The effect of light is very remarkable. It has been shown to accelerate corrosion very markedly, even after the temperature effects had been removed. Corrosion is clearly affected by barometric variation. The subject is very complex, and the results are not always the same, even when experiments are carried out under what appear to be exactly identical conditions.

An International Water Dispute of some moment has been settled with the final award of the Joint Commission for the measurement and apportionment of the waters of the St. Mary and Milk Rivers between the United States and Canada. By giving Canada the preference in the waters of the former stream and the United States that in the flow of the latter, but arranging for a minority interest of each nation in the other's stream, the Commission has reached a decision mainly satisfactory to both parties.

Novel Lighthouse Construction.—A combined lighthouse, dwelling and fog-signal room for Fairport, Ohio, on Lake Erie, marks a new method of erecting for exposed locations. The shell of the building was fabricated, riveted and bolted permanently together ashore; without interior mason work or lantern it was 28 feet square with a 38½-foot tower at one corner, and it weighed 65 tons. It was moved on the deck of a small steamer 147 miles up the lake to its location, at a transportation cost of $1350. The plan is estimated to have saved about $10,000.

A Heat-Treatment Problem.—In the course of a lecture before the Birmingham Metallurgical Society, Mr. E. R. Taylor, says *Engineering*, described an unusual form of trouble which was experienced in the heat treatment of some small engine parts. The right degree of hardness failed to develop, although the composition was quite up to specification. The cause was discovered to be a current of air passing along the bed of the muffle, producing a film of oxidation on the surface of the steel. The matter was remedied by scattering small fragments of charcoal about the size of peas over the bottom of the muffle, the engine parts being put into the muffle on a tray. The charcoal became oxidised instead of the steel, and the trouble was corrected.

Creosoted Sleepers.—It is generally assumed that a bridge built of creosoted sleepers would burn more readily, in the event of its catching fire, than would a bridge of non-heated timber. An experience with an 108-foot 9-span creosoted timber ballasted deck trestle bridge on the Nashville, Chattanooga & St. Louis Railroad in May last disproves this assumption. Starting at one end of the trestle and fanned by a high wind, the fire spread over the structure rapidly and burned intensely for some time. Following the fire, an examination revealed the fact that with the exception of charring which the timbers suffered and the burning of a few braces to a degree which necessitated their renewal, the structure was little the worse for its experience.

A New Type of Track Torpedo has been officially adopted on all lines of the Canadian Pacific Railway. It appeals to all three senses, producing on detonation not only a loud report but simultaneously a brilliant flash and a pungent smell. It is called "meteor" and is fastened to the tracks by means of two spring rail clips made of tempered steel or spring brass. In this way a firm gripping of the rail head is assured and at the same time a prompt application of the torpedo is made possible. It is completely waterproof, will stand any atmospheric conditions of heat, moisture and frost. It has been subjected to 100 hours' immersion, and one hour in moist steam at 120 degrees Fahrenheit without deterioration, and has been used where the temperature was many degrees below zero with complete success. Special tests have been carried out to ascertain its holding power when placed in position on the rail, and for flying particles likely to cause injury to bystanders. These have all been carried out with satisfactory results.—*Canadian Machinery.*

Science Notes

The Thickest Skin is found on the palm of the hand, where it is 20 times as thick as on the eyelid. The protection is proportionately greater in the palms of the working man.

Rescuer of Livingstone Dies.—Sir John Kirk, pioneer African explorer and the second white man to see Victoria Falls, died at Seven Oaks, Kent, on January 15th, aged 89. Once, on the Zambesi River, Sir John saved the life of Livingstone by shooting a hippopotamus that was charging Livingstone's craft.

A Great Zoo Planned.—Mrs. Harold F. McCormick purposes to install in the forest reserve she recently donated to the county a zoological garden, modeled after the Hagenbeck Gardens of Germany, that shall be the finest in the world. Dr. Josef Hartmann, who accompanied Mrs. McCormick from Europe, has been engaged to survey the location and draw up the plans.

In Memory of John Burroughs.—Marshal Foch, after receiving an honorary degree from Columbia University, laid the cornerstone of a building on 155th Street, between Broadway and Riverside Drive; this was the culmination of a two-day program honoring John Burroughs, other features of which were a memorial meeting at the American Academy of Arts and Letters and an exhibition of artistic and literary memorabilia.

The Municipal Observatory at Des Moines, Iowa, which is said to be the only municipal observatory in the world, was opened last August. The observatory building is to be equipped by Drake University with an 8-inch equatorial telescope. It is to be under the control of the university and open to the public at least three times a week, and at any other time when occasion may warrant.

Telepathy in Vienna.—The vogue of telepathic and hypnotic demonstrations sweeping Vienna has proved so demoralizing to both mediums and spectators that all such seances have been forbidden. It is said that actual crimes were attempted through hypnotic influence and that many nervous persons were seriously deranged. Physicians will be licensed to use such methods, but only in remedial treatments.

Energy Expended in Marching may be measured by the volume of CO_2 expired over a 50-meter (54.58-yard) course. This is, roughly, .0061 cubic inches per 2.2046 pounds per horizontal meter (39.37 inches). A soldier weighing 160 pounds and carrying 60 pounds, marching 2½ miles per "hour" of 50 minutes, will expend about 250 calories per "hour," or 1000 calories in 4 "hours," over a level course of 10 miles.

New Vaccine in Pneumonia.—A harmless vaccine treatment, requiring three injections at intervals of four or five days, has proved its value in the epidemic of pneumonia that accompanied the wave of influenza sweeping New York. This vaccine, developed by Dr. Park, director of the Bureau of Laboratories, was distributed to public dispensaries and private physicians as fast as the city laboratories could produce it. It gives protection in a very large number of cases and, where an attack does follow its use, it is usually a mild one.

Safety First Among Children.—The Bureau of Education points out that the time to begin inoculating the principles of safety is in the formative period of child life—specifically, in the kindergarten. It is more important to learn how to move than how to sit still and in teaching children to run about without bumping into each other and into the furniture we have a good beginning toward teaching them to take care of themselves on the streets. A traffic game, growing naturally out of these diversions, lays the basis of respect for law and order.

A Tale of Wealth From a Tomb.—Mexican archaeologists are to investigate a strange story concerning the French archaeologist, Count Brisac de Saint Denis, who recently died in Paris. It is circumstantially asserted that while doing research work in Mexico, near Comala, he discovered the tomb of an ancient Toltec king, in which was a collection of pearls, opals and gold dust worth $10,000,000, and that he managed to smuggle this wealth out of the country. All that is absolutely certain is that the Count did investigate some old ruins near Comala, about 1910.

Sleeping Sickness to be Studied.—The cause of this disease, and the means whereby it is transmitted, have long been the subject of study; it remains for the Tropical

Diseases Prevention Association to send an expedition to Uganda to investigate its treatment. Four physicians and two veterinary scientists conduct the party, and for several years they will carry out this work in different centers; it is hoped that a general system of vaccination may be developed that will confer immunity on those exposed to the disease.

Facts and the Rain-Maker.—M. Angot, director of the French Meteorological Office, has demonstrated that even in the extreme case of two equal masses of saturated air, one at 0° C. and the other at 20° C., in order to produce a .04-inch fall of rain it would be necessary for the two masses to mix rapidly and thoroughly throughout an atmospheric layer of four miles in thickness; that dust particles and ions (the nuclei of raindrops) are not sufficient of themselves to cause precipitation without an accompanying reduction of temperature. The chance of man-made explosions causing rainfall is thus seen to be extremely small.

The Ancient Order of Apothecaries.—Apothecaries were accepted as constituting a distinct branch of the medical profession long before the time of Henry VIII, though legal recognition may have come somewhat later. The earliest-known mention of an apothecary dates back to 1273, when Bardsley, in his "English Surnames," writes, "The Mayor of York was one John Le Espicer, aut Apotecarius." This would indicate that the terms "spicer" and "apothecary" were then synonymous, but Chaucer knew them as distinct from one another, the apothecaries confining themselves to drugs; they were originally assistants to physicians.

Bottles and Forest Fires.—A certain "Henry" has been breaking into the newspapers with the claim that bottles thrown away by drinkers are "responsible for starting more forest fires than anything else." These bottles, he says, act as burning glasses by focusing the rays of the sun on dry leaves. Now it happens that a burning glass is an accurately-ground convex lens; without committing ourselves to the statement that never, under any conditions, can a bottle cause a forest fire, we should like to see Henry marooned with a bottle, and to watch his efforts to ignite leaves by its means alone. It's a wonder travelers have not discovered this virtue in the bottle.

Ancient Engineering Instruments.—English historical research, as applied to science, brings to light some interesting descriptions of Greek and Roman engineering instruments. Vitruvius cites the use of the dioptra, chorabates, and water levels in surveying, up to 100 A.D., and gives sectional drawings showing these instruments, of which no complete example remains. He also shows the groma, an arrangement of two crossed arms at right angles with suspended plumb lines at the ends, used for setting out straight lines and lines at right angles. The dioptra reached an advanced stage of development, and instruments and methods have many striking points of similarity with those of today.

German Ambition in Optical Goods aims at nothing less than dominating the world market. Last year the School of Optics and Phototechnique was founded in Berlin so that manufacturers and venders of lenses and specialties might learn the last word concerning their products. Among the new specialties are the lorgnon—a lorgnette with a single eyeglass, often worn fixed to a bracelet by a short chain; and a small opera glass weighing but six ounces, yet having a field of vision more than 25 yards in diameter. German optical exports are said to be almost up to pre-war figures and bring returns that enable manufacturers to make exceptionally reasonable prices in the home market.

Glass Kept Clear of Moisture.—The glass of windows, windshields, and goggles soon loses its transparency when moisture is condensed upon it. A recently patented process prevents this by coating the surface of the glass with a layer of transparent, gelatinous substance, insoluble in water under ordinary conditions, which possesses the quality of absorbing and dissipating moisture. This coating may be toughened, softened, or tinted by the addition of other substances. Indoors, the use of the coating on walls hides the discoloration due to "sweating," and mirrors may also be kept clear by the same means. The water vapor has no appreciable effect on the substance, which continues automatically to exercise its alternative functions of absorption and release of moisture for an indefinite time.

When Tables Tip

(Continued from page 406)

festations; nor do I expect my readers to accept them off hand. Those who may be interested can find the whole story in Dr. von Schrenck-Nötzing's book "The Phenomena of Materialization," and Dr. Geley's "From the Unconscious to the Conscious," wherein the whole account is given, and a number of the photographs reproduced.

These manifestations are, of course, the most incredible and the most perplexing with which psychical research deals; and they are led up to by a series of simple experiments, which have been undertaken in the past, in "telekinesis," or the alleged movements of objects without contact. For these, there is excellent evidence, which may be considered conclusive, indeed, so far as it goes. Many of these phenomena depend, apparently, upon an energy which is radiated from the body and which, without contact, moves objects within the immediate environment. A medium may place her fingers an inch or so above a metal-box, say; and, after holding them from that position for a few moments, make a sharp movement, and the box will be moved. There is thus a sort of vital bridge or connection established between the tips of the fingers and the object in question, and this has been proved in several cases, in which a medium has succeeded in discharging an electroscope without contact, merely by holding the tips of her fingers an inch or so above it.

There is here, it must be admitted, a field for legitimate scientific research which borders partly upon the physical and partly upon the biological realms. We seem to get very closely into touch with the nature and origin of life, and of its active manifestation, as well as with the subtle forces which animate the living organism. There is every reason to believe that researches along these lines will eventually culminate in some of the greatest and most startling conclusions of modern science, and that these despised and ridiculed psychic phenomena may be the means, after all, by which we shall be enabled to interpret the nature of life.

I have said that manifestations such as these lend themselves to scientific investigation and solution; and attempts have been made, of late years, to investigate them by laboratory methods, just as any other phenomena of physical or biological science are investigated. Thus, we have a device which is intended to register the physical pressure of the human *will*. A light board, some 18 inches in length by 12 inches broad, is supported on two knife-edges, some distance from the center, so that one end of the board weighs more than the other. This longer end is supported, by means of a thread, to a delicate balance, which registers the normal weight of the board, as it hangs suspended from the scale. The subject experimented upon is requested to place the fingers lightly upon the shorter end of the board, and look intently at the longer end.

Now it will be seen that any pressure exerted by the hands will cause the longer end of the board to move upwards, and hence weigh *less*. No upward pull can be exercised at the shorter end of the board, for the simple reason that the subject can only remove her hands altogether—in which case the normal weight of the board is registered. If, therefore, an *increase* of weight is noted, this must be due to some pressure exerted on the longer end of the board. The subject is told to look at this end of the board intently, and to *will* that it shall be depressed, and, in a certain number of cases (perhaps 2 per cent of those tried) a slight downward pressure is recorded.

Another device known as the Sthenometer is intended to register the vital radiations issuing from the finger-tips. A straw is supported on a needle-point so as to oscillate freely in either direction, over an indexed circular card. A bell-jar of glass is inverted over this, so as to shut off air-currents and similar normal forces. The subject is then requested to place his finger-tips close to the glass, opposite the end of the straw, and to *will* that an energy shall proceed from his finger-tips and displace the straw in question. In a certain number of cases, this is readily noted; and Dr. A. T. Schofield, of London, asserts that it is to be noted particularly in hysterical and epileptic cases. It is not the heat of the hands which causes the movement of the straw, since, even when the hands are cold, this effect is noted; and, on the contrary, a hot iron will fail to move the straw. And it is not ordinary electricity, for which the glass would act as an insulator. I do not say that the movement of the straw, in these cases, is due to any definitely supernormal cause, but there is obviously here a case for further investigation, and it is precisely in these odd phenomena that psychical research consists!

I have no space here to deal with other interesting psychic manifestations, such as the human "aura," "thought photography," the experimental projection of the "astral-body," weighing and photographing the "soul" at the moment of death, etc. But enough has been said, at any rate, to show that there is here a definite field for legitimate, scientific investigation, and that psychical research may in future be classed as a recognized *science*, taking its place among other sciences, worthy of the highest efforts of the best minds of the century. It is my hope that this will, ere long, be recognised, and that psychical research may be regarded as the science which attempts to solve the riddle of man's existence, of his unknown powers, as well as his future, which no other science attempts to penetrate!

Planning Big Crimes

(Continued from page 388)

of bullion was to be hauled down Wall Street to the docks. This shipment left the sub-treasury in a wagon — it was before the day of automobiles. Dugan and his pals in a lighter vehicle met the official cart between the sub-treasury and the dock. Driving up close, they were covered with an assorted variety of hardware in the hands of the wagon guards. Flashing his and his pals' counterfeit sub-treasury badges, Dugan explained that everything was all right. "There's a plan to hold this wagon up a couple of blocks down. Instructions are to unload the bullion into our wagon. We will take it to the dock; your job is to drive straight ahead and be held up. Give 'em a fight; shoot 'em like rats and bring them in, dead or alive." The bullion was transferred, and Dugan's wagon drove away. The other cart went on, looking for hold-ups. They didn't find any, because they had already been held up without knowing it. Incidentally, the police unravelled this one and sent all hands to the penitentiary.

From the ear-marks it appears that the first step in planning the recent $2,000,000 post office truck robbery in New York City was to corrupt an employe of the post office. The crooks who used two automobiles to hold up the registered mail truck showed by their immediate and accurate selection of valuable mail pouches taken that they had advance and competent information concerning the shipment. They also had what might be termed blue-printed knowledge of the route and time of the shipment. It is possible that they actually did have blue-prints because many crooks are good engravers, draughtsmen, mechanics. They come from all classes and walks of life. There is also food for speculation in the thought that the truck was not properly armed or guarded.

In planning the corruption of an "inside" man, in a criminal "job" of this nature, the crooks make a business of meeting the man to be corrupted outside his business hours. They begin by feeling him out and making him dissatisfied with his position and income. They use Socialistic arguments and stress the vast wealth that can be his if he will depart a little from the "straight and narrow."

There is a chance that a pretty girl was used to help corrupt this fellow, whoever he is. A pretty girl could be used without her knowledge of the real purposes back of her flirtation. She would most likely be of the "gold-digger" type. She would be given some money and a big scare. She might be told that unless she did as she was told, she would be murdered, dismembered and thrown into the bay. The actual killing and dismembering has been done in more than one robbery and white-slave case. The corpses turn up every now and then to prove it.

What might be called an epidemic of mail robberies has swept the country. I account for this by the "fall" of some former or present employe of the department, who has joined out with some gang of thieves and has spread information through the underworld concerning the methods of the handling of the mails. Such information travels fast. With inside information to work on that would tend to insure success in such robberies, various gangs would rush into the new line of criminal endeavor. It would start all the criminal architects and engineers to planning intensively, and would take them from other work on which they might be engaged. In other words, criminal talent would desert the regular diggings, for the time being, while they engineered and opened up the new mine.

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Lack of space makes it impossible to give many cross references, or to enter a given reference in more than one place. Each article is accordingly entered at the place where it is believed it will be most easily found. In every case the general subject should be sought, rather than the supposed specific title of an article. Frequently articles are not indexed under their specific titles at all; *e. g.*, the article "The Peer of Decorative Hardwoods" will be found indexed under the classification "Forests and Forest Products," and under the specific entry "Rosewood." In every case it is the endeavor thus to place the entry so that it will be found by one seeking references to the subject discussed in the article. We call special attention to the classifications "Household Appliances," "Machines and Machine Tools," "Machinery and Power," "Machines for Special Purposes," etc., in which many items will be found whose location otherwise would be very puzzling, and which can be examined item for item in the search for a doubtful entry with much greater ease than can the entire alphabet. The short notes that comprise the columns of text on the advertising pages are indexed only by their general headings, and not specifically for each note. The asterisk (*) indicates that the article in question is illustrated.

The North Atlantic Ice Patrol

(Continued from page 371)

request to all steamships in the vicinity of the Grand Banks to send in their position, course, temperature of sea water, and ice formation. . . . Stood across Grand Bank to the southward and eastward for a berg reported on May 9th. . . . Stood to eastward and northerly in search of a berg . . . running as far north as 44° 30' without success; subsequently received information that this berg had been caught in the warm northerly current and had broken up into small pieces close to the 45th parallel. . . . Set course to northward and eastward and on the evening of the 20th located a berg. . . . Ran along the eastern edge of the bank during the 21st, and located a small berg. The weather shutting in thick, drifted. Stood into edge of the bank and anchored with bergs in sight, observing their drift during the 23rd. On the 24th steamed to the northward and eastward to observe two reported bergs. Found them just about sunset when fog shut in thick. From the 26th to the 30th worked to westward in dense fog, riding out a northeast storm on the 30th and 31st. Fifty-six vessels co-operated with the "Tallapoosa," during the first and second ice patrol cruises. All these vessels crossed the Bank, or very close to the danger area, and respected the information received. It is worthy to note that the steamship "Cassandra," the only known vessel that failed to cooperate or to heed the warnings sent out relative to danger areas, met with an accident by striking a berg."

Such is the work done day by day, and by night, by the vessels of the Coast Guard, during the three months of ice peril off the Grand Banks.

The World's Wages—a Statistical Anomaly

(Continued from page 369)

In Great Britain, even the agricultural laborers are strongly organized, and work but 50 hours a week—an unheard of minimum for farm help.

For farm help, we have in this country two rates: "found" and "board out." The latter is used as it seems to be more comparable with foreign practice. In the building trades, averages are taken for New York City where the United States is concerned. The figures would vary for other localities, usually being somewhat less; there is no uniform American rate.

With these explanations, we may say that in the United States carpenters get $9.00 per day; in Great Britain, $3.26; in France, $2.54; in Belgium, $1.91; in Japan, $1.37; in Italy, $1.34; in Spain (for 1919; no later figures available), $0.87; in China, $0.30; in Germany, $0.24. For plumbers there is no serious discrepancy from the above figures, save for Great Britain, where the plumber, perhaps because of the universal British preference for the old-fashioned "tub," seems to be at a disadvantage. The rates here are, for the United States, $9.00 again; for France, $2.54; for Belgium, $1.67; for Italy, $1.34; for Great Britain, $1.06; for China, $0.35; for Germany, $0.25; while Japan and Spain are missing altogether. For masons and for painters the wages are the same as for carpenters in the United States, Great Britain, France and Italy. In Spain both these trades receive $1.06 and in Germany both get $0.25. The Belgian mason gets $1.82 and his brother of the brush only $1.60; in Japan the mason has a similar advantage, of $1.58 against $1.36; in China the mason gets 30 cents and the painter three cents more.

The carpenters seem to be pretty representative of the building trades, both as regards work done and in point of pay received; so we employ them in our graphic comparison of page 369. A wholly different situation exists among agricultural laborers, and calls for a new picture. The figures on which this is based are as follows: the farm laborer in the United States gets $3.59; in Belgium, $1.46; in Great Britain, $1.32; in France, $1.29; in Japan, 89 cents; in Italy, 67 cents; in Spain, 39 cents; in Germany, 16 cents; in China nobody knows how little he does get.

Of course, the superficial sum of money paid labor today is universally greater—far greater—than 10 years ago. The French carpenter of 1911 got 9 francs a day, and now he gets 28 francs. At par, in 1911, he got $1.73; at 1922 exchange he gets $2.54. But it is doubtful if his wages have kept pace with prices—if he gets as much food or if his wine is as good as ten years ago.

Wool from Cotton

IT is well known that cotton is used to adulterate wool. Many a woolen garment contains appreciable amounts of cotton. The ordinary person is almost at a complete loss to tell whether a suit of clothes, a dress or coat is made of pure wool or not, and it is only by examination under the microscope that the textile chemist can affirm conclusively the absence or presence of other fibers besides cotton in the garment. Now, there has appeared a patented process whereby cotton is made to assume the properties of wool not only physically that is to feel, appearance and caloric qualities, but chemically as well in its affinity and absorbent capacity toward coloring matters. Pretty soon the chemist himself will be unable to tell the two fibers apart.

These properties are bestowed on cotton when the products of a slow decomposition of protein substances caused by strong mineral acids are fixed on the fiber. The results may be obtained in various ways. Either the cotton may first be impregnated with the liquor of dissociation, the latter squeezed out and the mineral washed, or else the fabric may be dipped in the protein solutions, then treated with the hydrolyzing liquid, squeezed out and washed. The exact order of the steps in the process does not effect the final results.

The proteins that are used are casein, egg albumen, serum albumen and gelatine. Various strong mineral acids, such as 65 to 80 per cent nitric acid, 55 to 65 per cent sulfuric acid, 25 to 37 per cent hydrochloric acid, etc., are used in hydrolyzing agents either alone or in admixture. Time of immersion and temperature are variable conditions which must be regulated according to the nature of the fiber treated, the particular protein used and the acid that effects hydrolyzation. Variation in temperature from 5 degrees C. below zero to 20 degrees C. above zero has no appreciable influence on the result obtained. The precipitation of the protein substance on the fiber is accomplished by merely washing the treated material in water. The process may be used on all vegetable fibers, either in the form of yarns or as fabrics, and it is also immaterial whether the fiber is mercerized or not.

An example of how the process is actually carried out is given in the following: A slightly ammoniacal solution of casein is prepared, containing about 10 per cent of the protein. The fiber is dipped in this solution, dried and then exposed to the vapors of formaldehyde for some time. It is then treated for about two minutes with 75 per cent nitric acid at the ordinary temperature, squeezed out or pressed out and washed. The yellow color of xantho-proteid which is developed by a secondary reaction may easily be removed by treatment with a weak carbonate of soda solution.

Light Gives the Alarm

OF all the instruments designed to trap the elusive burglar, a German device, called "the electric eye," is one of the most ingenious. Most burglar alarms are caused to operate by the action of some direct contact, such as pressure on a door or window. The electric eye operates quite independently of any such contact, direct or indirect. The inventor of this alarm has taken advantage of the fact that a thief does not usually work in the dark; though his step may be stealthy and his touch light and skilled, he almost never fails to carry some kind of a lamp or flashlight to prevent him from stumbling, and to enable him to see just what is worth "lifting." And it is this light which is to be his undoing.

The operation of the electric eye is based on the action of selenium. Selenium is a remarkable chemical element, which is known to be a non-conductor of and a resistant to electricity in the dark; but as soon as light falls upon it, it becomes an electrical conductor. If it is inserted in an electric circuit, it operates to break off the electric current as long as it is in darkness; but even a faint gleam of light causes the current to flow on again.

The apparatus is quite simple. It consists of a small, but highly sensitive selenium cell, in a little box, about six inches square. The cell is inserted in an electric circuit. It is connected up with a special intermediary apparatus, known as the "call," and to some other apparatus which is usually spoken of in various mechanisms as the "relay." The call operates with the flow of the current and starts the contact with the bell which gives the alarm. This bell contact may be installed in the room of a watchman; or several alarms may be installed in various parts of the house so that the alarm may be given in more than one place. The electric resistance of the selenium cell in the dark operates to cut off the flow of the electric current through the conductor so that the alarm apparatus is put out of circuit until a stream of light falls on it.

This brings up the question whether ordinary daylight will not operate to give the alarm. Of course, special care is taken to prevent this. So long as the room is lighted by daylight or artificial light, the selenium cell is made light-tight by means of a flap. When the room is vacated and is left dark, the electric eye again is inserted into the electric current and the flap over the selenium cell is lifted. Then, because the room is dark, the apparatus is put out of circuit. The device is also operative in a room which is not in absolute darkness, for the susceptibility to light of selenium can be regulated. For example, if light from a street lamp falls in a room, the electric eye can be adjusted to that light so that the electric current is shut off. If additional light is brought into the room, the dim light already there is strengthened and the apparatus is put in operation. Experiments have shown that even the faintest of lights will operate to give the alarm. For this reason, the electric eye may be a protection against fire as well as burglary.

The box inclosing the selenium cell is so small that it may be hidden in a hundred inconspicuous places, where it will be unobserved and where it will work effectively. It may be placed behind the carved work on a clock, behind a mirror, placed unostentatiously on a pile of papers in a desk, or wherever the imagination of the electrician may dictate. It may be provided with other protective devices which will operate at the instant the bell contact is accomplished. There may be special protective conductors for safes. There may follow a putting out of all lights. Even after the installation improvements may be added to the electric eye. And if the thief happens to know of this particular method of alarm, and attempts to disable it by cutting the circuit, his effort is fruitless; for the very act of cutting the conduction will give the alarm.

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